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CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

No one can comprehensively survey the telephone situation to-day without being profoundly impressed by the brilliant future which it presents. The record of telephone development in the past assures one that it would be a wise man or a rash one who would attempt to set the limits of the almost boundless growth which it seems to hold forth. That there is a disposition to make the study of telephone engineering one of serious importance is evidenced by the fact that some of the most notable of our college institutions are now embodying a special course in telephone practice in their curricula, and there is no doubt but that with the coming of next season's session it will be found that a great impetus will have been given to the study of this branch of engineering.

THE IMPORTANCE OF THE STORAGE BATTERY.

The storage battery is becoming more and more in evidence, as its value in certain situations and the proper methods of handling it get to be better understood. It has suffered in the past more from external ignorance than from internal defects. Applied in many instances to meet conditions to which it was not adapted, usually overworked, nearly always uncared for, it has been the ugly duckling of the electrical art.

Engineers generally know but little about it and its limitations. They frankly admit the fact, and seem to care little that it is so. Electrochemistry is out of their sphere, they say, and battery mathematics are not intricate enough to attract the learned. The truth remains, however, that the storage battery is a good friend, and an ever-present help in the time of trouble, if it be properly laid out and installed, and does not suffer from persistent neglect.

The principal defect in a storage battery is its modesty. It does not spark, creak, groan nor slow down under overload. It does not rotate. It stays where it is put, and will silently work up to the point of destruction without making any audible or visible sign of distress. If it does not cry for attention none will be given it. If a rule is laid down by the general manager, that at certain intervals a battery must be inspected and cleaned; that the point of discharge must not be carried below 1.8 volts per cell; that an occasional overcharge must be given; that electrolyte density must be maintained; these things may be done, but if they are it is generally in such a careless, haphazard manner as to vitiate their value—all because there is no indication on the part of the battery that it needs some attention. Men who will polish the bolt-heads and terminals of a dynamo will allow a battery to go quietly to pieces without giving it a thought. Noise seems to count in this world.

All this may seem an impeachment of the intelligence of station men and operators, truculently made, and bordering on querulousness. However this may be, the facts bear out statements.

Lately, however, there seems to have been an awakening interest in this subject on the part of station managers and investors, and there is now going on among them an earnest search after that kind of knowledge which will enable the definite determination of the question of dividends. When this information is all obtained and assimilated, the truth seekers will find as a basic starting point they have the condition, that the larger the battery the higher will be its efficiency and the longer its life, and opposed thereto, the larger the battery the greater its cost. There is, somewhere between the limits of excessive and deficient sizes, some size in which the total loss of energy, depreciation and interest will be least.

Where the load is fluctuating, or where there is a heavy peak of short duration, a battery, rationally selected as to the capacity, and the installation of which is skilfully engineered, would be an investment seldom ill advised, provided the small amount of attention necessary is given it. However, peaks which require a continuous discharge of more than two hours usually call for such a large battery that the price is prohibitive.

The efficiencies of batteries are higher than they are generally credited with. It is true that when rapidly discharged, and carried down below 1.85 volts per cell, the efficiency is not over seventy-two to seventy-five per cent. If, however, the battery is large enough to handle the load at moderate discharge rates, and is stopped at the proper point of discharge, the efficiency may run up as high as eighty-five per cent in well-designed cells.

It is on regulation, however, that the battery stands forth as the only panacea for shock, jar, strain and all the evils attendant on fluctuating load—not the least of which is the matter of increased

fuel consumption. The efficiency on regulation is far greater than is usually supposed, running as high, in some cases, as ninety-seven per cent, or equal to that of a first-class alternating-current transformer. The classical experiments of B. Hopkinson showed that the average efficiency that may be expected in practice is ninety-three per cent.

The efficiency of boosters has also proven a stumbling block. It is true that these machines do not have as high an efficiency as ordinary dynamos of the same kilowatt capacity, and, furthermore, that they are usually running on a load which is a fraction of their normal output. If the problem be approached from the standpoint of the actual energy lost being the result sought, its solution becomes easy, and the booster loss is found to be much smaller than seems to be currently believed.

That there are many situations where a battery could never pay is undoubted, and it is advisable to study the problem from all its aspects before making an installation. It is equally true that there are situations where a battery adapted for the work will decrease the operating cost sufficiently to make a substantial dividend on the whole plant.

In some installations the conditions are such that a battery is necessary for successful operation, and to produce satisfactory service, regardless of the financial considerations.

The supplying of lights and elevators in buildings from the same generators is an example of this case.

Another interesting and useful application is in connection with rotary converters operated in parallel, the equalization of the load effectually preventing oscillation and "hunting."

Altogether, there seems to be a growing demand for power batteries, and as their limitations and operation become better understood their performance will become more satisfactory and their dividend paying possibilities greatly increased. The storage battery has an important place in industry and with the exercise of proper care in its handling it will undoubtedly justify the claims of its exponents.

COPPER VS. IRON LOSSES IN DYNAMOS.

Iron losses in dynamo electric machinery are constant and continuous, while copper losses vary with the load except in the case of constant-current machinery where the reverse is true. It has been said that the machine user cares not how the power is lost, but concerns himself only with the gross amount. From an economy standpoint alone this is strictly true, but there are other considerations besides economy, and therefore the user is interested in just where the losses go. Excessive loss of either variety, even if compensated for by lesser loss of its mate, is highly undesirable for the reason that the parts in which the heavy loss is dissipated get excessively hot. Clearly it is better that the iron structure rather than the insulated winding be deputed to carry the heat, and therefore watt for watt it is better to a certain limit to carry the loss in the iron, particularly as small copper loss is a guarantee of good inherent regulation in constant potential work, which constitutes by far the largest volume of work done by dynamo-electric machines. If the load is variable, however, the all-day efficiency will suffer with large constant iron losses, and hence discretion must be employed in selection.

With large machines, the best central station practice is to keep them fully loaded at all times, and the all-day efficiency consideration does not enter. In constant-current work, where the copper loss is constant, it must be minimized as far as conditions of regulating will permit.

The conclusion plainly is that small machines will be best with a larger percentage of copper loss than large ones. However, if the machine is small, efficiency is a much less important consideration. Therefore, it may be set down as a general platitude that in the design of dynamo-electric machinery, the copper loss should be rendered at the expense of the iron loss as far as possible without interfering with the performance specifications. This means strong fields, small armature reaction and fixed and sparkless commutators. The gain in reliability in keeping the heat out of the coils, and the sparks from the commutators, and the improved inherent regulation, are together more important than the all-day efficiency.

Finally, and not least in the consideration, the machines with high iron losses, by reason of their structure, need less material for their construction and possess correspondingly reduced first cost, and may, in this respect, afford a saving in the initial investment which will represent enough interest to offset in part the diminished all-day efficiency.

THE GROWING APPRECIATION OF HIGHER TECHNICAL EDUCATION.

Higher education in the electrical and mechanical arts is receiving a growing appreciation on the part of employers, as is strikingly evinced during the present season by the demand of large manufacturing companies for young and well-trained graduates. Within a few weeks the editors of the ELECTRICAL REVIEW have received several enquiries from the heads of large companies, advising that they were desirous of giving employment to numbers of young graduates, such employment to begin by actual shop service, with the prospect of rapid advance through the various departments of machinery making. Then, for as many as are available and desire the service, opportunities would be found for enrolment in the business departments of these companies. Perhaps the reason for the desire on the part of these manufacturers for college-trained young men is due in a measure to the fact that college faculties in planning for mechanical and electrical curricula during the past year or two have considered more carefully the elimination of excessive theoretical study, and have given the students the greatest possible amount of real shop work and practical experiment.

The standardization of telephone apparatus seems to be rapidly becoming an accomplished fact in many of the standard types of instruments, though it seems doubtful, owing to the diversity of applications of the telephone, whether this can ever be accomplished actually and completely. The remarkably successful introduction of the central energy system has in a measure worked a great change in telephone apparatus, and now that much consideration is being given to automatic systems, there is a further possibility of still more radical evolution.

THE NATIONAL BUREAU OF STANDARDS.*

BY DR. FRANK A. WOLFF, JR.

In response to a widespread demand on the part of the scientific, educational, technical and manufacturing interests of the country, to which the National Electric Light Association also gave expression, Congress, on the very last day of the last session of the Fifty-sixth Congress, passed a bill establishing the National Bureau of Standards.

The functions of this Bureau are:

To consist in the custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions with the standards adopted or recognized by the government; the construction, when necessary, of standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

. . . The Bureau shall exercise its functions for the government of the United States; for any state or municipal government within the United States, or for any scientific society, educational institution, firm, corporation or individual within the United States engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments.

In view of the general interest manifested in the establishment of the Bureau, particularly on the part of the electrical fraternity, an invitation was extended by your honorable president to Professor S. W. Stratton, its director, to give you a brief outline of its plans, and to give you some information in regard to the progress which has been made. Owing to the inability of Director Stratton to be present, I have been designated to appear in his stead.

The Bureau was formerly organized July 1, 1901, after the scope and general plans had been thoroughly discussed with the members of the visiting committee and many others.

A beautiful site of seven and one-half acres, in the northwestern suburbs of Washington, was procured within convenient access, but not too close to the car line to seriously interfere with any but the most precise measurements, which will, of course, constitute but a very small portion of the work to be undertaken. Moreover, this difficulty is easily surmountable by working after midnight when necessary.

The law appropriated $100,000 for a building, the cost of which was limited to $250,000. To meet the demands of manufacturing and technical interests for heavy testing work, and for experimental work requiring extraordinary facilities, a large and well-equipped power plant is required, and this makes necessary the erection of a separate power-house at some distance from the main building. The elaboration of the numerous details of construction of the two buildings occupied a great deal of time, and as the work progressed its scope broadened with it, so that when the preliminary estimates of the cost of erection of buildings of the necessary size had been made by the supervising architect of the Treasury, under whom the buildings are to be erected, it was found impossible to construct them for the sum specified. An additional appropriation of $75,000 was therefore asked for, and has just been granted.

The main building will be four stories in height, approximately 150 feet long and 50 feet wide, and will contain about fifty rooms, all equipped with apparatus for verification work and for special investigations, and provided with gas, electric light, compressed air, suction, hot and cold water, as well as with a number of independent electric circuits, so that electrical currents of any desired character may be obtained.

The importance of temperature control in a physical laboratory has long been appreciated, and it is especially desirable in an institution where standardizing work is to be done, as nearly every result depends at least to some extent upon the temperature at which the measurements are made. Accordingly, means will be provided for closely regulating the temperature of any room at any desired temperature, both in summer and in winter, as will be more fully described below.

In most laboratories the basement, which on general principles would really be most suitable for precise measurements requiring the greatest stability and freedom from vibration, has to be devoted to the heating, lighting, ventilating and power plant, and to miscellaneous purposes. As a special power-house is here to be provided, the basement of the main building, which is almost level with the ground and well lighted, will be utilized solely for the more precise work. Four of the rooms are to be fitted up as special temperature rooms.

The basement will be vaulted over, so that the first-floor rooms will be almost as free from vibration as those on the floor below, and will therefore also be utilized for laboratory purposes.

The second floor will be set aside for the administrative and clerical work, for the library and for the museum, in which standards and apparatus of historical importance will be preserved.

A well-equipped chemical laboratory will be fitted up on the third floor, part of which will accommodate a laboratory for photometric research. There will also be provided on this floor a lecture room with a seating capacity of 150 to 200. As it will be the policy of the Bureau to keep in close touch with the interests it serves, it is hoped that it may soon be in a position to extend invitations to scientific and technical associations to hold their meetings from time to time in Washington.

THE MECHANICAL LABORATORY.

The mechanical laboratory will be a three-story building, 135 feet long and 50 feet wide, and will contain the power and lighting plant, storage batteries, special alternating-current machines for experimental and testing purposes, the refrigerating plant, the heating and ventilating plant, auxiliary apparatus, the machine shop and carpenter shop, as well as laboratories for heavy electrical testing, photometry, gas and water-meter testing.

Boiler Room—In the boiler room two 125-horse-power boilers are to be installed, space being provided for doubling this capacity.

Dynamo and Engine Room—Two eighty-horse-power high-speed engines, each direct-connected to two twenty-five-kilowatt direct-current generators, will be installed. Additional space will be provided for a unit of double this size as well as for the special alternators referred to below.

The Heating and Ventilating Plant—In the combined heating and ventilating system to be adopted the air will be supplied to the various rooms by means of ducts, with the aid of electrically driven fans, the temperature of any room in either building being independently controllable by a thermostatic damper at the bottom of the respective flues, where the heated or artificially cooled air will be mixed with the air from without. The ducts are so proportioned as to permit a complete renewal of the air every fifteen minutes. In winter the air to be heated will be passed over the coils fed with exhaust steam, and in summer the air will be cooled by

*Read in abstract at the Cincinnati meeting of the National Electric Light Association, May 20-23, 1902.

coils through which cooled brine is circulated.

Refrigerating Plant—To cool the air and to provide artificial ice, a refrigerating plant of thirty tons ice melting capacity will be installed. Although the building will be used only a portion of the twenty-four hours, provision will be made for fully utilizing the refrigerating capacity with the aid of a brine tank of sufficient capacity, the refrigerating machine being operated throughout the whole night when necessary.

Instrument Shop—The instrument shop, a most important adjunct to a modern laboratory, will be equipped with the latest types of motor-driven precision and engine lathes, milling machines, shapers, drill presses, etc. The shop has not yet been organized, but three or four mechanicians are provided for from July 1, 1902.

A liquid air plant of sufficiently large capacity for all experimental purposes likely to arise is also to be installed.

The auxiliary apparatus will consist of an exhaust fan for ventilating hoods, the storage battery room, the toilet room, etc.; air compressors, vacuum pumps, pumps for circulating the hot and cold water, etc.

As the public gas mains are not yet laid as far as the site, a gas plant will also be installed.

A storage battery room of considerable size is to be provided, and an adjoining room is to be fitted up for heavy current testing. Several of the rooms on the first floor will be used for experimental work, although no doubt as the work of the Bureau develops additional buildings will have to be provided, and the first of these will, in all likelihood, be an electrical laboratory. The mechanical laboratory will then be given up principally to power purposes and to the instrument shop. From present indications this contingency is likely to arise even before the buildings now planned are ready for occupation.

The third floor of the power-house will, for the present, be devoted to gas and incandescent lamp photometry, and to gas and water-meter testing.

The opinion has been expressed that the Bureau will not be ready to undertake verification work for some years, pending the construction and equipment of the buildings. Recognizing the importance of immediate work along a number of lines, temporary quarters have been secured in the Coast Survey Building, and arrangements are now being made to secure additional quarters near-by. In these apparatus will be installed and put in actual use as quickly as possible. Some of the work is already well under way.

One of the rooms has been fitted up for photometric purposes, and while the Bureau is not yet ready to verify incandescent lamps as photometric standards, the necessary apparatus has been delivered or is about to be delivered so that actual work can soon begin, and it is hoped that an announcement can be made within the next six months that photometric standards will be received for verification. Provision will be made for arc and Nernst lamp photometry, as well as for the photometry of Welsbach and acetylene lamps and other commercial types. The Bureau will exert its efforts to provide for a practical means of determining mean spherical candle-power at the earliest opportunity. The question of photometric standards will also receive consideration, it being recognized that while the Hefner lamp is the best standard available, it is more than likely, judging from the researches at the Physikalisch-Technische Reichsanstalt, that a standard superior in every respect may soon be realized.

THE VERIFICATION OF ELECTRICAL STANDARDS AND MEASURING APPARATUS.

Pending the construction of primary mercurial resistance standards, a number of one-ohm manganin coils have been adopted by the Bureau as preliminary standards of reference. The values of these are certainly known to within 0.002 per cent, in terms of the primary mercurial standards of the Reichsanstalt, and errors due to variations are avoided by periodic reverifications at that institution. The construction of primary mercurial standards and secondary mercurial standards will very shortly be undertaken.

The manganin standards of the Bureau, which range from 0.0001 to 100,000 ohms, have been subjected to repeated intercomparisons, the value of the multiples and submultiples of the units being determined in terms of the one-ohm coil. The Bureau is thus equipped to undertake the verification of resistance standards, resistance boxes, potentiometers, ratio coils, volt boxes and ammeter shunts, except for the present in cases where the resistance is to be determined when carrying large currents.

Facilities will shortly be provided for determining the specific conductivity of materials used for electrical conductors, and also for the determination of the tensile strength of such materials. Provision is also being made for the determination of insulation resistance, as well as dielectric strength and capacity of insulated wires and cables. The Bureau is prepared to receive for verification Clark and other types of standard cells, the values of which will be expressed in terms of the mean of about three dozen Clark cells which have been constructed at the Bureau.

The Bureau is also prepared for the verification of direct-current measuring apparatus of limited range, in limited quantity, millivoltmeters and voltmeters up to 150 volts, ammeters up to 100 amperes, and arrangements are being made for increasing the range to 2,000 volts and 1,000 amperes, when direct-current wattmeters, watt-hour meters, etc., will also receive attention.

Special facilities will be provided for alternating-current testing. The alternators for experimental and testing purposes will all be driven by direct-current motors operated from the generators, or when necessary from independent storage batteries. Thus for investigating the influence of the higher harmonics on measuring instruments, condensers, transformers, arc lamps, etc., a set of motor-driven alternators, having relative frequencies of 1, 3, 5, 7, 9, 11, 13 and 15 times the base frequency, will be provided. All of these machines are to be connected to one shaft, and will be arranged so that the amplitude and phase of any component may be varied independently. The base frequency may be varied between 25 and 125, though the latter frequency it will not be possible to work in the highest harmonics.

From this necessarily brief outline of the plans of the Bureau it will be seen that provision will be made for the verification of every type-measuring apparatus which the electrical engineer is likely to submit, and it is hoped that as soon as the buildings are completed the Bureau will be in a position to undertake for the National Electric Light Association, and for similar bodies, the solution of important technical problems requiring extraordinary experimental facilities, and to cooperate with them in every possible way within its proper scope.

A plain sand mould is not advisable for small brass castings, for when hot metal comes in contact with fresh sand the latter partially melts and a rough casting is the result. To obviate this, finely pulverized charcoal is dusted upon the mould, or the mould is smoked with cork shavings or pitch torches by which a very fine coat of carbon is deposited and a smooth surface obtained on the casting. Carbon does not adhere well to old sand; when it is used, it is necessary to first dust the mould with pease-meal and then add the carbon. Avoid excess of both, otherwise the casting will come out faint instead of sharp, the carbon collecting in the hollows and preventing the metal from running up.

Apparatus for X-Light Diagnosis—II.

Being a Continuation of Notes on X-Light.

By William Rollins.

In the last chapter Fig. 11½ was shown. It consists of two square pieces of hard wood, each one metre long, sliding in sockets which can be clamped to any part of the frame of the examination table. These pieces of wood are connected by a piece of canvas. The distance between them can be varied from the entire width of the examination table, as in Fig. 10, to a narrow strip, as in Fig. 8, by rolling the canvas about one piece of wood; Figs. 4 and 5 also show the apparatus in use.

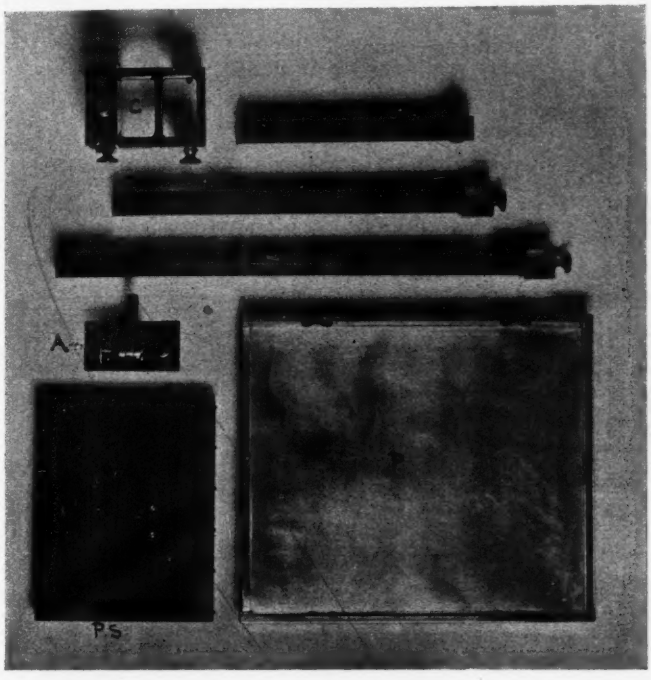


FIG. 12.—APPARATUS FOR SUPPORTING PHOTOGRAPHIC PLATE.

APPARATUS FOR SUPPORTING A PHOTOGRAPHIC PLATE.

In earlier notes it was stated that a photographic plate which was to be used in making a picture by X-light should be contained in a thin metal holder to protect it from breakage by the weight of a patient and from perspiration and urine. The importance of allowing no unnecessary X-light to strike the plate was pointed out and figures were given of a plate-holder which accomplished these results. The plate-holders shown in the illustrations accompanying this note are those already figured, as longer use has proved them to be satisfactory. The apparatus for holding them in any position in regard to the patient is also the same as that of earlier notes. The present illustrations and descriptions are given to show its universal character. That an apparatus with so few parts should be capable of such varied use is interesting. As yet, after several years, no case has been seen where the photographic plate could not be firmly held in proper position by this universal plate-holder clamp. The fundamental support is the piece C,

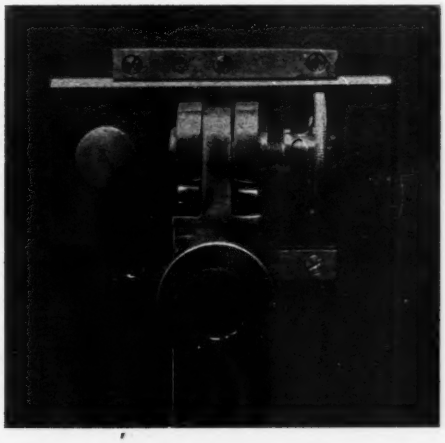


FIG. 13.—PIVOT PLATE.

Fig. 12, which can be clamped to any part of the side or end bars of the examination table. The other parts are—three square brass tubes with sockets at their ends provided with milled-head screws—a plate, A, with a front; a wooden sheath, PS.

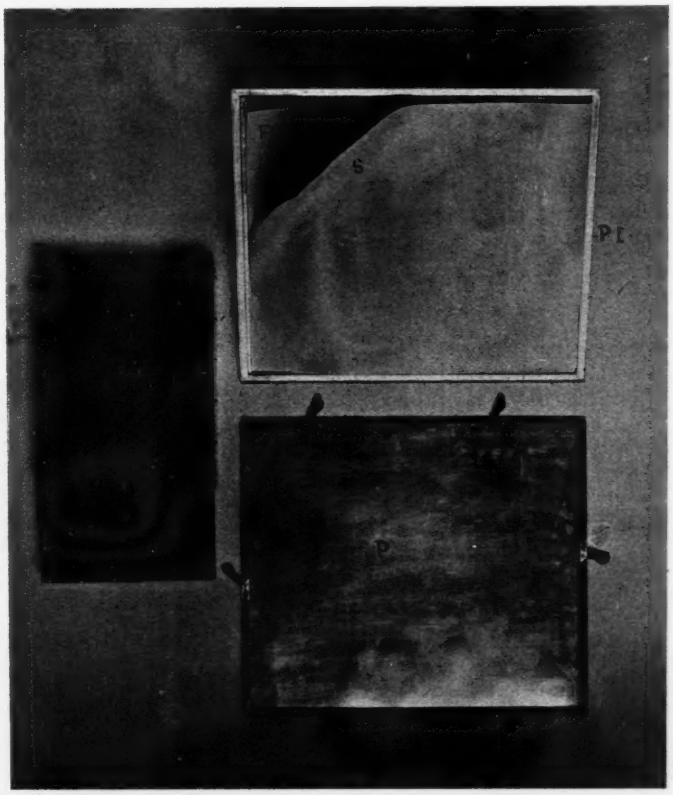


FIG. 14.—PLATE-HOLDER DETAILS.

The plate-holder slides into the wooden sheath which is simply a mahogany board thick enough to make a firm support for the plate-holder and for the attachment of bars, EE, Fig. 13, which hold the pivot plate (A, Fig. 12). Around three sides of the board is a brass rim forming, in connection with it, an open scabbard for the plate-holder. The small cut in Fig. 14 shows the front of the wood in plate-holder sheath with an 8 by 10 plate-holder partly withdrawn.

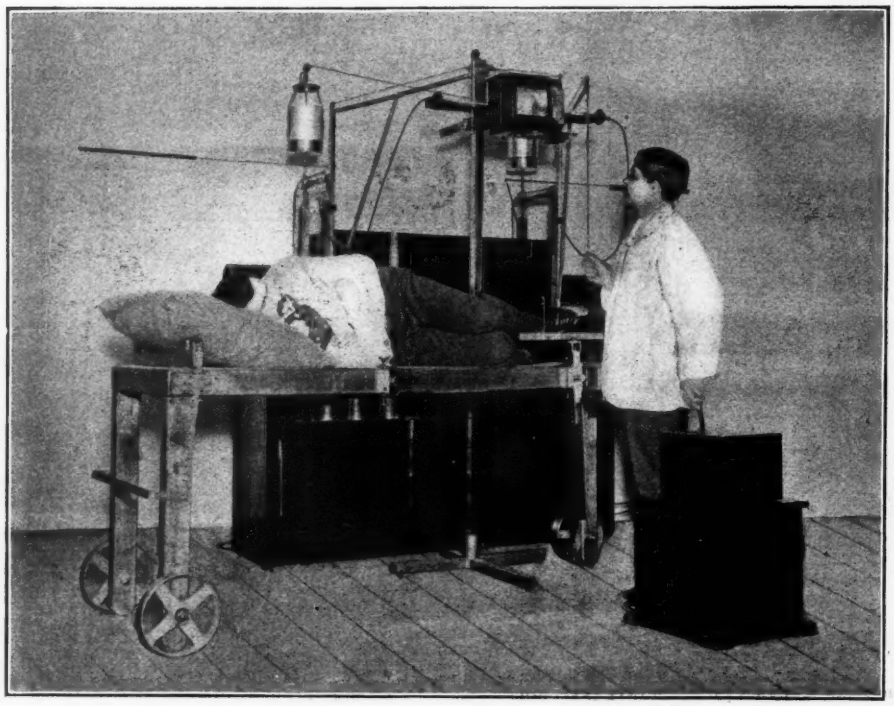


Fig. 15.—Showing Position of Apparatus in Photographing Ankle.

Fig. 13 is a view of a part of the back of the wood sheath (PS) to show in detail the pivoted plate which connects the plate sheath with three arms, shown in Fig. 12.

A number of sheaths are required. The best sizes are those which will take plate-holders for plates 8 by 10 by 14 by 17 inches. Each sheath has on its back the two bars EE to allow the same plate (A, Fig. 12) to be used with any plate sheath. The milled-head (A, Fig. 13), by exerting pressure, prevents the sheath from moving. D is the arm on which the sheath turns. C the milled-head which firmly clamps the sheath in any position. This milled-head is not a continuation of the axis on which the plate sheath turns, as that arrangement was found not to clamp firmly without the application of great force. The largest milled-head shown in Fig. 13 allows the sheath to turn in an arc whose plane is perpendicular to the page and at right angles with the other arc about D.

Fig. 12 (P) is a 14 by 17 plate-holder. Fig. 14 shows it open, exposing the photographic film and fluorescent screen.

Figs. 4, 5, 5½, 9, 10, 11, 15 and 16 also illustrate a few of the positions in which this apparatus will hold the photographic plate. All these figures show clearly how necessary it is to have the tube-case and plate-holder supports with universal movements, that the central ray of the cone of X-light escaping from the tube box shall strike the photographic plate normal to its surface. To impress this necessity is one of the reasons why so many illustrations have been made.

NOTE CXLI—SOME REMARKS ON CAPACITY AND POTENTIAL IN COILS USED FOR EXCITING X-LIGHT TUBES.

One of the most interesting features of the coil described in notes cxii and cxxxvii was the ability to alter the character of the surges. Apparently this is a matter not yet understood. Therefore, even at the risk of repetition, it will be reconsidered in connection with a few illustrations which show how to arrange a coil. In coils prior to the one illustrated in note cxii, where the terminals were separated to their furthest limit, we had the full potential and capacity of the coil. When the terminals were near together the capacity was unchanged, but the potential of the current in the X-light tube current was reduced. In this coil the capacity of the surges used to excite the tubes can be varied within wide limits, by the Leyden jars of different capacity in the secondary current, by the arrangement of rods which form the terminals of the coil, by the arrangement of the spark-gaps in the tube circuit.

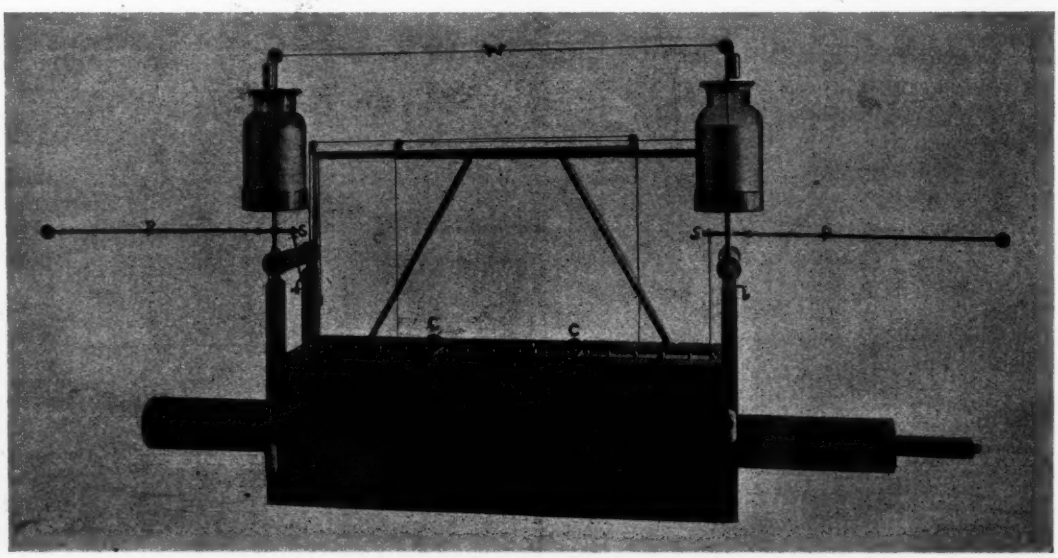


Fig. 16.—Rods Arranged to Give Full Capacity of Coil.

Fig. 16 shows a seventy-one-centimetre coil with the rods (PP) arranged to give the full capacity of the coil. They touch the last

balls, therefore all the coils of wire are in use. The Leydens are of one gallon capacity, which is as large as is generally useful with this coil. Large jars cut down the potential, as there is not enough current to fill them with sufficient rapidity. CC are the wire loops connecting the coils of the secondary of each of the three sections into one continuous coil of wire. The rods PP are hollow, other rods terminating in the brass balls SS sliding within them. W is a fine copper-wire cable connecting the inner coating of the jars. This is made taut by the weights hanging above the jars. If an X-light tube were placed in connection with the terminals of the coil thus arranged it would be broken by the strain if its resistance was high. To avoid this danger the coil should be arranged as in Fig. 17 where the Leyden jars and the whole number of coils in the secondary are used as before, but the internal rods are drawn out from the hollow rods (PP, Fig. 16) until the distance between the balls (SS, Fig. 17) is but a few centimetres. The potential strain on the tube is therefore limited to the length of the spark-gap S, Fig. 17. In Fig. 18 the rods PP are pushed toward each other, and the section bands (CC, Fig. 17) are removed, thus making all the turns of wire in the secondaries of the two outer sections of the coil inoperative. The Leydens are also removed. In this way the capacity of the coil is greatly reduced.

If we arrange the rods, as shown in Fig. 18, but leave the bands CC, Figs. 16 and 17, then we get a condenser effect from the coils of the two outer sections, yet the potential of the coil is still low.

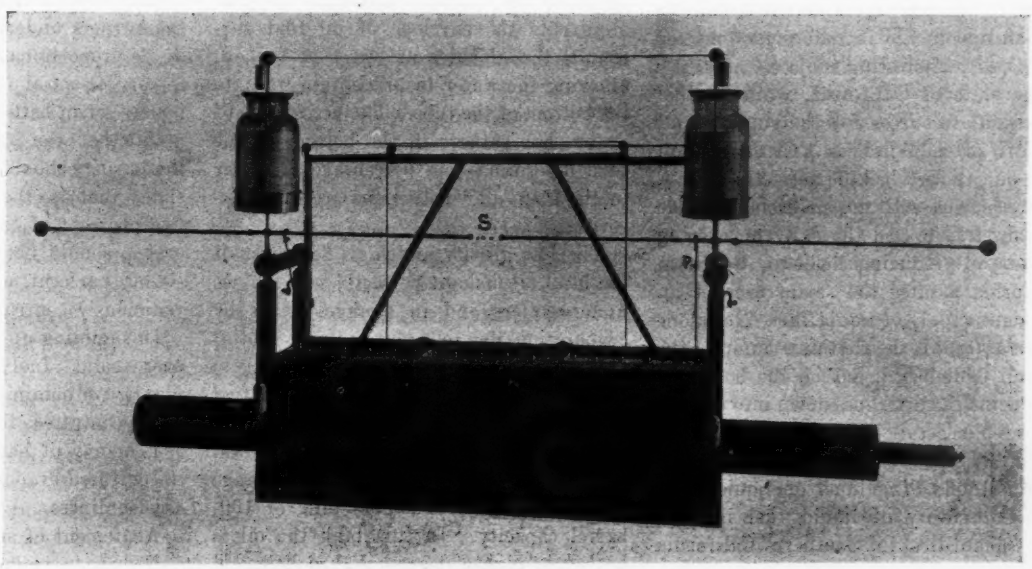


Fig. 17.—Showing Arrangement of Internal Rods Drawn Out from Hollow Rods.

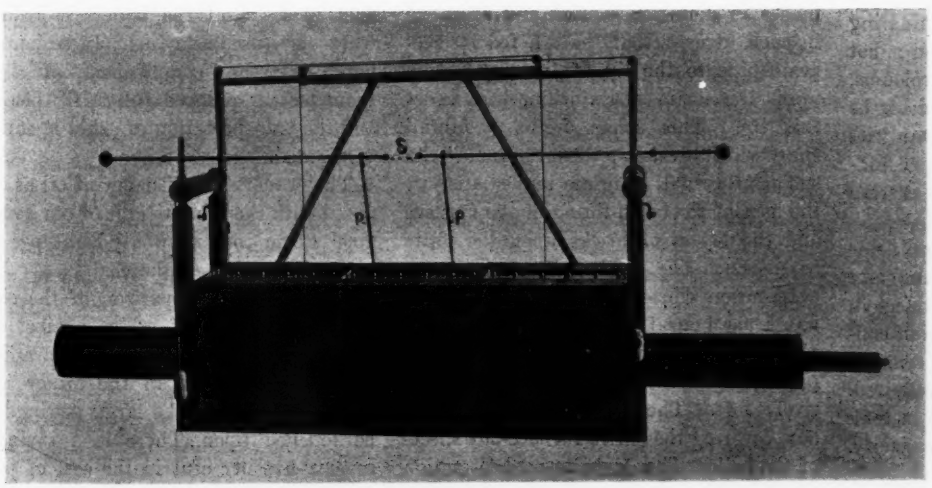


Fig. 18.—Arrangement of Rods, Reducing Capacity of the Coil.

It has been clearly shown in former notes that to properly excite an X-light tube we must store the electricity in a reservoir, allowing it to rush through the tube in such amounts as are best suited to the size of the cathode and the condition of the tube, and at such intervals as will allow the longest periods of rest to permit the tube to recuperate between the surges.

On account of the present importance of this procedure coils should be constructed to make it easy.

In the last few notes apparatus has been, perhaps, rather fully described and illustrated, but there existed a good reason, namely, a desire to make the structure of apparatus embodying the principles advanced in this series of notes on X-light so clear that any good mechanic could construct it for a physician who desired suitable mechanism for using X-light. X-light is capable of playing a great part in medicine, but its use is restricted, even now after seven years.

NOTE CXLII—CORRECTIONS TO NOTE CXXXVII.

The gauge numbers given in note cxxxvii for the sizes of the double-covered cotton wire used in the secondaries are incorrect. They were not in my manuscript, where the sizes were given in fractions of a millimetre. The correct figures are as follows: For the fifty-six-centimere coil the diameter of the wire was thirteen one-hundredths of a millimetre. For the seventy-one-centimetre coil the diameter of the wire was twelve one-hundredths of a millimetre. Attention is again called to the fact that these coils were designed only for electrolytic breaks. If they are used with mechanical breaks and a condenser in the primary the spark length is less than the figures given, though otherwise the performance of the coils is satisfactory. These corrections and remarks are made because the writer has received a number of enquiries from persons in different countries asking questions which show that they were contemplating constructing coils from the descriptions given.

LIQUID FUEL—BOILER FIRING WITH OIL.*

BY JAMES W. WARREN AND H. T. EDGAR.

JAMES W. WARREN.

The chemical composition of liquid fuel and its calorific value as compared with that of solid fuels have been so ably presented in various papers that it is hard to find an opening to introduce new matter on this very interesting subject.

The state of California, while prolific in natural resources for the support and comfort of mankind, is a little shy on coal; but, though lacking the solid carbon, we are blessed with an increasing volume of hydrocarbon, and the daily uncovering of new oil-producing fields in Southern California assures the steam user of an abundant supply of liquid fuel. Not alone on *terra firma* is the rhythmic bump of the oil-well drill heard, but on the bosom of the Pacific the drill goes down into the bed of the old ocean, and, tapping the oil strata, we draw from under the mighty deep millions of gallons of liquid fuel.

The discovery of liquid fuel in such large quantities in Southern California has made its use general for all manufacturing purposes, also for the burning of brick, oiling roads to subdue the dust, for smudge fires to temper Jack Frost, for malt houses, for all steam railroads in Southern California, and for crematories.

The petroleum oils of Southern California are of an asphaltum base and carry with them about thirty per cent of asphalt. There being little paraffin and a comparatively small amount of illuminating oil in their composition, distillation is not as general as with eastern petroleums. The greater amount of distillation of the local petroleum is for the large quantities of asphalt it carries, this asphaltum finding a ready market here and in the eastern states.

The liquid fuel from our local oil fields is pumped from wells within the city limits. These wells average 1,000 feet in depth. The oil carries in suspension considerable sand and water, for the removal of which storage and heating are required. This oil is delivered to consumers in tank wagons of about twenty-barrel capacity. When the oil is delivered to the consumer a sample is taken from the wagon and tested for temperature, gravity and percentage of water. The average temperature is seventy degrees Fahrenheit, the average gravity fifteen degrees Beaume, and the percentage of water averages about six per cent of the load in the wagon. The method of determining the amount of water in the oil is by the gasoline test. This test is made with a test tube holding 100 cubic centimetres and graduated in one-hundredths. The tube is filled with fifty cubic centimetres of the oil test and fifty cubic centimetres of gasoline. By agitating the mixture thoroughly the gasoline cuts the envelope of oil that surrounds the globules of water in the oil, allowing the water to precipitate itself to the bottom of the tube. The percentage of water that gathers in the bottom of the tube determines the percentage of water in the load, and deductions are made accordingly.

The low gravity and high flash test of the local oil make it perfectly safe for use under boilers and in storage. Loss by evaporation, due to exposure to the heat of the sun, is comparatively small.

The method of handling the liquid fuel at the generating station of the Los Angeles Electric Company is as follows: The fuel is pumped from the main storage tank to the furnace supply tank of 100-barrel capacity. In this tank the oil is heated to eighty degrees Fahrenheit. It then passes to a pair of small duplex steam pumps which give it twenty pounds gauge pressure. The oil then traverses pipes within the breeching of the boilers, which heats it to 190 degrees Fahrenheit, then on to the burners. The burner is of the spray type, using steam as the medium of spraying the oil. These burners consist of two circular discs, one and one-half inches in diameter, slotted and arranged in such manner that the oil, fed by separate pipe to the lip of the upper disc, meets the steam at its orifice just under this lip. This steam forms a fantail spray which breaks up the oil into particles sufficiently small to ignite immediately by the heat of the brick lining of the furnace and the layers of bricks upon the grate bars. Each one of these burners has an evaporation efficiency of 3,000 barrels of water per hour from and at 190 degrees Fahrenheit. The sound of combustion produced by these burners is comparatively soft. The flame fills the furnace box, covering the entire furnace-box sheets of the boiler. This gives active heat action to all of the evaporative service of the fire sheets without unduly heating any one particular portion, and, at the same time, perfect combustion is taking place, as denoted by the absence of any colored gases leaving the stack.

If economy in the use of liquid fuel is to be considered, a high-temperature thermometer in the smoke stack is as necessary as a water-gauge glass on a boiler, for by the thermometer only can the fireman graduate the amount of air necessary for perfect combustion. As a test of this, our fireman can raise the temperature of the gases in the stack from 450 degrees to 600 degrees Fahrenheit by closing the ash-pit doors one inch. By the use of the thermometer the fireman can so regulate the burners under each boiler that it will do its proportionate amount of work. This is very essential in plants working many boilers set in batteries. It is an important point that the evaporative efficiency of the burners should be kept as high as possible; that is, the burner that consumes five per cent of the steam which it evaporates, should not be allowed to consume twenty per cent, which it might do if not judiciously controlled.

In summing up the advantages of liquid over solid fuel for steam-generating plants, we obtain the following:

Concentrated form.
Economy of handling.
Increased evaporative efficiency.
Cleanliness.
Abatement of smoke nuisance.
Reduction in depreciation account.
Reduction in repair account.
Reduction in sundries account.
Efficiency in emergency.

In considering the comparative storage area required for coal and for the equivalent amount of oil, taking yard storage as a basis, forty per cent less area is required where oil is used. In the floor area of the fire room fifty per cent less floor area in front of the boilers is required when oil is used as a fuel. In economy of handling, the complement of boiler room help is reduced fully fifty per cent and the transportation of ashes is entirely eliminated.

The evaporative efficiency of oil as compared with the same weight of our average good steam coal is twenty-eight per cent higher than that of the coal.

In making a comparison of the cleanliness in the use of oil as against coal, and the saving gained, the advantages are so far-reaching in the minor items that only a few of the larger savings will be touched upon. There is a saving of seventy-five per cent in the cost of paint, waste, brooms, tube cleaners, etc., required in the everlasting removal of coal dust, dust from ashes, soot, etc.

The use of liquid fuel solves the smoke problem, as smoke issuing from a stack where oil is used for fuel is an evidence of improper combustion, and can be avoided.

The use of liquid fuel reduces the de-

* Read before the National Electric Light Association at its twenty-fifth convention held at Cincinnati, Ohio, May 20, 21 and 22, 1902.

terioration of steam-generating apparatus twenty-five per cent. This is effected by the even fire of fuel oil, there being no undue strains on the fire sheets, caused by the frequent opening and closing of fire doors, as in the use of coal. The absence of large amounts of sulphur in oil prevents those chemical combinations whih so rapidly corrode the tube ends. Ashes, lodging in obscure places and inaccessible corners of the boiler, absorb moisture and form a strong chemical affinity for the parts of sheets with which they come in contact, causing rapid corrosion.

As to the reduction in repair account, the cause of renewing the lining of furnaces, renewing grate bars, bridge walls, back arches, etc., is reduced eighty per cent by the use of liquid fuel.

In the reduction of the sundries account, the items of coal scoops, slice bars, hoes, firing irons, tube scrapers, wheel-barrows, water hose, steel brooms, wood for starting fires, etc., are entirely wiped out when liquid fuel is used.

In the use of liquid fuel the engineer has an able assistant to help him out in case of an emergency call upon his boilers. If required to raise steam rapidly he can do so without endangering the burning out of his boilers as greatly as when coal is used. On the other hand, if for any reason it is necessary to shut the fires off immediately, it can be done without the annoyance and danger of pulling out a heavy fire from the furnace.

In conclusion: The record of results obtained from the use of liquid fuel in Southern California stands out so prominently in liquid fuel that many of the larger steam-generating plants in the northern part of this state have abandoned the use of coal in favor of liquid fuel. Its simplicity in operation and control, and the low cost of installation, make it a desirable factor in the economies of a steam plant.

H. T. EDGAR.

The use of oil under boilers is by no means a novelty, but a practical everyday experience with many of us. No doubt a great many members are quite familiar with burning fuel oil, and the information contained in this paper will not be new to them, but to those of you who are not familiar with the subject a few facts may be of interest.

To the people of Texas the fuel oil question is one of vital importance, and will undoubtedly do more to increase her manufacturing interests than any other one industry within her borders. To those of us who have been compelled to burn bituminous coal costing from five to six dollars a ton, the discovery of fuel oil in the Beaumont oil fields came as a welcome relief, as its use as a fuel has relieved us of those excessive manufacturing costs that were a constant drain on our resources. There is undoubtedly in existence a great deal of data on the subject of burning oil, as very extensive experiments have been made, but this paper is only intended to treat of the subject in a general way.

Fuel oil was first discovered in Lima, Ohio, in 1885, by Mr. Ben. Frotte, who was boring a well, hoping to obtain water but finding oil instead. It has been discovered in many parts of the United States and Canada since that time, but its use under boilers at Lima is supposed to have been the first application of oil as fuel. There are large oil wells in Pennsylvania, Ohio, and most of the western states, particularly in California. In most of these places crude oil is not used as a fuel, but is refined and the by-product used for burning. The oil is discovered at different depths in different parts of the country, and varies from ninety to two thousand feet.

Fuel oil was discovered at Beaumont in January, 1901, and up to the present time there are about 220 six-inch and eight-inch wells, most of them being from one thousand to one thousand and fifty feet in depth. A great many of these wells are gushers, but it is only a question of time when the oil has to be pumped, and all of the wells will sooner or later become pumping propositions.

There is a great deal to be written in regard to the burning of fuel oil. Its economy depends entirely upon the style of the boiler and the manner in which it is handled. In some places fuel oil is burned, not because it is cheaper than coal, but because it has a great many advantages over coal. We find in the use of fuel oil that it increases the capacity of the boilers slightly and the capacity of the chimney about thirty per cent. In addition to this, it decreases the costs in the fire room. It is necessary to employ, however, in the fire room high-class labor, and our experience has been that the man in charge must be competent and fully up to the standard of a first-class fireman, for while there is not much hard work to be done the entire apparatus requires constant and intelligent care.

The high price of coal has been the means of inducing all steam users to investigate the question of fuel oil, and it is being put in use very rapidly. During the seasons of 1901 and 1902 about three per cent of the industries of Texas were burning fuel oil, and the calculations are that during the seasons of 1902 and 1903 about thirty per cent of the industries will be using it.

There has been considerable anxiety felt as to the effect of fuel oil on the boilers and stack. The following is taken from a letter from the chief inspector of the Hartford Steam Boiler Inspection and Insurance Company of New Orleans, addressed to Mr. H. F. MacGregor, president of the Southwestern Gas, Electric and Street Railway Association, dated April 17, and refers to the experience of that company with fuel oil:

"At the outset our inspectors received special instructions concerning the new fuel, and were cautioned to use special vigilance to the end that its effect on the boilers under our charge might be ascertained as quickly as possible. Thus far the closest scrutiny has failed to reveal any deleterious effects where proper care was exercised in installing the oil-burning apparatus and in its operation afterward. Some apprehension was felt at first that the amount of sulphur contained in the crude oil might be sufficient to cause more rapid deterioration from pitting and corrosion than had been experienced with coal. This fear has thus far proved groundless, no extraordinary pitting of tubes and shells having been noted since the introduction of oil as fuel. This may be accounted for by the fact that the amount of sulphur liberated per thousand heat units is less with oil than with coal.

"The wear and tear upon the boiler structure is probably less with oil than with coal. Much of this wear and tear with coal is due to strains produced by the sudden and frequent inrushes of air against the hot plates and heads while furnace doors are opened for firing, resulting often in leakage at seams and tube ends and small fractures of the boiler plates. These are almost entirely avoided by using oil for fuel. The doors are never opened and the temperature remaining practically even, there are no injurious contractions."

The method of burning fuel oil, the changes necessary in the boilers, the style of burners, etc., are practically the same in all cases, but a brief description of the installation in the electric light plant at El Paso, Tex., may be of some interest.

(To be concluded.)

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—XXIX.*

BY A. E. DOBBS.

In Figs. 109 and 110—previously shown—the magneto drop and jack circuit is shown, and Fig. 110 shows how the drop is cut out of circuit upon the insertion of plug. It is necessary, however, that we should have some means for knowing when the subscriber is through talking. In order to do this there is generally another drop, called the "clearing out" or "ring off" drop, in the cord circuit. This drop may be placed either in series or multiple, and in Fig. 123 we show the clearing-out drop attached to the cords themselves by both methods, the upper drop being connected through the cord in series, while the lower one is bridged across its cord in multiple. This is shown without any other appliances for the sake of simplicity. The series drop, however, is not now used to any great extent, as its impedance on one side of the circuit tends to unbalance the line and interfere with the voice waves. For this reason a 500-ohm clearing-out drop is used almost exclusively in switchboards of the present design.

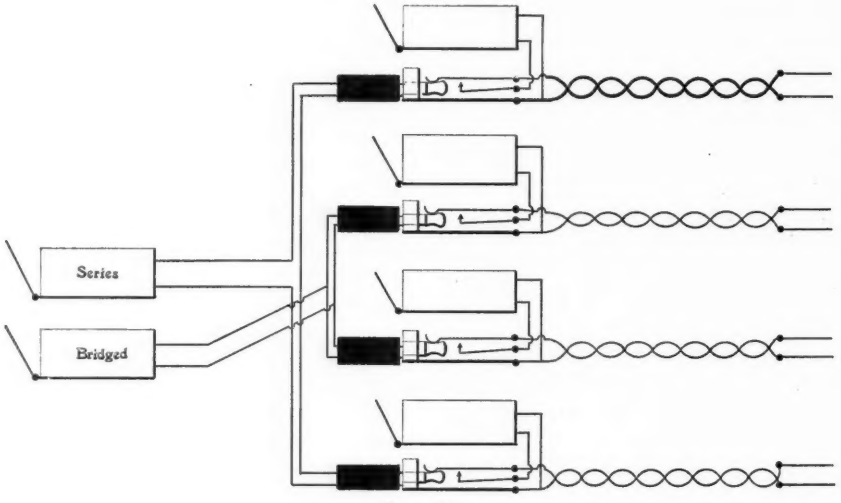


FIG. 123.

THE CORD CIRCUIT.

To the average beginner the most complicated part of the switchboard is the cord circuit, yet if carefully followed it presents no more difficulties than a circuit-changing switch, the trouble being that there are several different functions performed by this useful device that are attached to a single key. We will take as an example one of the simplest cord circuits originally in use, which it will be comparatively easy to understand. In Fig. 124 this key is as simple as that of a telegraph circuit. In the first place, the drop is on one side of the line in series. In nearly all boards the back cord, or the plug farthest away from the operator, is known as the answering plug. Following the circuit through this plug, it will be seen that the circuit passes from the tip on the right to the tip on the left without a break. On the sleeve side, which is connected to the shank of the plug, we find the circuit passing through contact, *c*, *c'*, and through the clearing-out drop which is placed in series. When the plugs are in position the circuit is then simply closed through the clearing-out drop. Now, suppose that a call should come in. The operator puts up the answering plug in the jack, and in order to ask the subscriber's number she presses down the key, K', which cuts out the drop, at *c'*, and also opens up the other side of her cord circuit. As long as she holds this key down, her transmitter and receiver are in the talking position, and she asks the subscriber what number he wishes. Upon restoring this key, the circuit is again closed through the drop. The next thing is to ring the subscriber wanted. To do this she must insert the calling plug in the jack and press down the key, K, which connects her with the magneto generator; but in pressing down the key, K, she also opens the circuit at the contact, *c*, thereby cutting out the subscriber who first called in. When this strap key is released the line is again closed through the drop, and the two subscribers are connected. This simple circuit was one of the first used, and is still used on some boards, and it will be seen to be no more complicated than an ordinary two-point push-button. In order that the operator may be able to use both hands, the talking key, K', is usually attached to a lever in such a way that when pushed down it remains in the down position until the operator releases it, which enables her to stay on the line as long as she chooses. The key, K, however, is held down only as long as she keeps her finger upon it, as it is not desirable to ring a subscriber for three or four minutes at a time, that number of seconds being generally sufficient. In a ringing and listening key this difference always enables an inspector to determine which is the ringing and which the listening side.

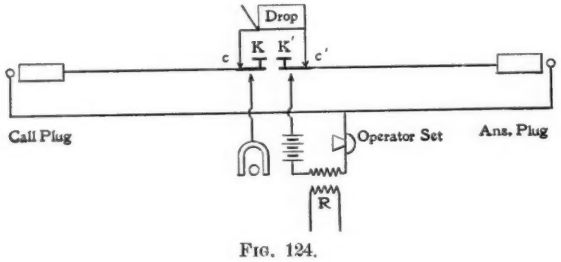


FIG. 124.

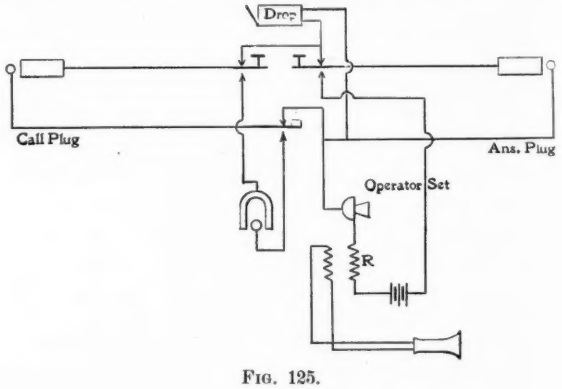


FIG. 125.

Sometimes with metallic circuits, bridged drops and party-line circuits it is considered desirable to complicate this key, but the principle remains the same. It is now generally customary to break the

* Continued from March 1.

cord on both sides, which makes a double contact key instead of a single contact, as shown above. One reason of this is that the generator is generally grounded, and if there should be a slight ground on the sleeve side of a subscriber's line he would be able to hear a continual hum from the generator, which would be objectionable. The single contact for the operator's transmitter, however, is still used by most manufacturers.

Fig. 125 shows the same circuit as applied to a bridged drop, together with the double contact for the generator, the single contact being left as before for the operator's transmitter. A great many changes can be made in a combination of this kind. Sometimes the listening key is so arranged as to cut in on the operator's secondary, instead of the primary circuit, the battery being constantly on the operator's transmitter from another source not connected with a cam at all. This, of course, leaves the operator's listening circuit open until she depresses the key.

In Fig. 126 the entire circuit connected with the plugs is shown. In the centre between the two pairs of jack springs we find a plunger or cam so arranged that it

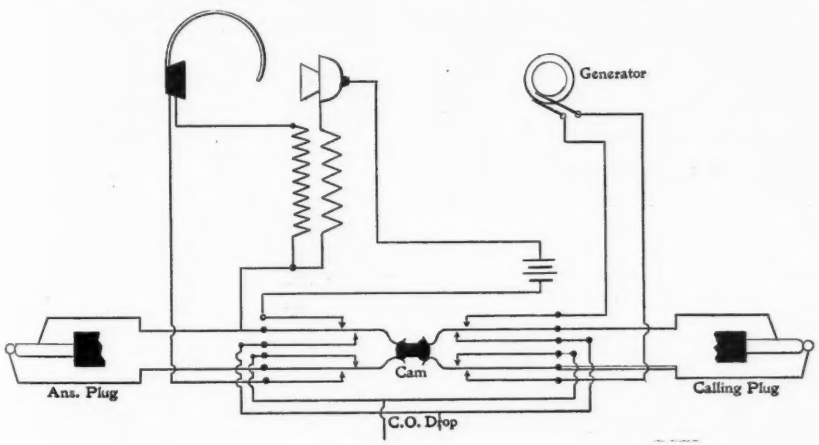


FIG. 126.

may be thrown either to the right or to the left by means of a lever not shown. It will be observed that pushing out the contact springs to the right-hand side cuts out the left-hand end of the line, and connects the generator to the line on the right. On the other hand, throwing this cam to the left cuts in the operator's transmitter and leaves the line open to the right. This, as explained before, is the reason why we have the back plug as the answering plug and the front as the calling plug. By throwing the cam on the generator circuit, the operator is enabled to call, while by throwing the cam to the talking circuit, which is the answering side, the operator is enabled to ask the number wanted. Suppose now that the generator contacts on this particular key was dispensed with, and in its place a shunt connection made to the operator's transmitter. It will be seen that depressing this cam to the right or to the left would enable her to talk to either of the lines as may be desired, and this form is very frequently used, as the operator is able to listen in either on the front or back board at will. By the use of another cam like the one shown, the generator can also be arranged to ring either front or back as may be desired. In purchasing a cam see that it possesses strong German silver springs with platinum contacts, as even in the simple cam shown in Fig. 126 it will be observed that there are four movable contacts in the line circuit, and with an inferior apparatus this becomes a frequent source of trouble. Sometimes these contacts are so arranged that the operator bridges in on the cord instead of cutting in on one side as shown.

The World's Copper Production in 1901.

The total output of copper in 1901 was 512,131 tons, as compared with 486,039 tons in 1900 and 472,244 tons in 1899. The largest contributors to this enormous total are the American mining companies, the output of the Lake and Western mines for the three years having been 262,206, 268,787 and 267,410 tons, respectively.

The production of the mines situated in Spain and Portugal during 1901 was 53,621 tons, as compared with 52,872, and 52,168 tons in the two previous years, and the output of these mines is unlikely to show any marked increase in the future. Australasia comes third in order of production, with an output of 30,875 tons in 1901, as compared with 23,000 tons in 1900 and 20,705 tons in 1899. This large increase in production is, of course, a direct consequence of the high price of copper in 1900 and 1901, and of the flotation of many new mining companies. We are doubtful whether this level of output will be maintained, now that copper is once more selling at £50 to £55 per ton. Chili occupies fourth place with a production of 30,000 tons, as compared with 25,700 and 25,000 tons in the two previous years. The increased price has here, again, led to new mining developments, which may not be permanent. Japan follows Chili with an output of 27,475 tons in 1901, a decrease, since this country produced 27,800 tons in 1900 and 28,310 tons in the preceding year. Mexico occupies sixth place with a production of 23,795 tons, as compared with 22,050 tons in 1900, and 19,335 in 1899. The increase of 4,000 tons is in the output of the outside mines, for the production of the famous Boleo mine remains stationary at about 11,000 tons. The German mines have produced 21,720 tons in 1901, as against 20,410 tons in 1900 and 23,460 tons in 1899. Here, again, there is a decrease to record in the figures for the three years, and Germany has sunk from the fifth to the seventh place as a copper-producing country. Canada, with an output of 18,800 tons in 1901, now ranks eighth in order of production, and the figures for 1901 show a striking advance upon the totals for 1900 and 1899, which were 8,500 and 6,730 tons, respectively. In this case the activity in the Sudbury mining district of Ontario is partly responsible for the increased production of copper, many of the mines which have been bought and worked chiefly for their nickel ores producing also cupriferous ores. Peru has produced 9,520 tons of copper in 1901, as compared with 8,220 and 5,165 tons in the two preceding years. Here, again, rapid progress is marked by the totals for the three years.

The Russian production in 1900 and 1901 is estimated to have amounted to 8,000 tons as compared with 7,210 tons in 1899, but these figures lack the weight of official returns.

South Africa ranks eleventh with an output of 6,400 tons, a decrease upon the figures for 1900 and 1899, which were 6,720 and 6,490 tons, respectively. The remaining countries each produce less than 5,000 tons annually, the output of the United Kingdom being given as only 600 tons.

Projected Electric Railway in Spain.

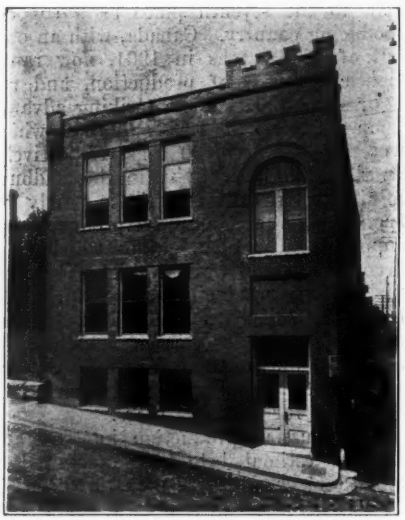
A royal decree grants a concession to Don Teodoro de Mas y Nadal to construct, within the next six years, an electric railway between the towns of Vich and Amer, in the province of Gerona.

The capital of 9,000,000 pesetas (about $1,200,000), which is estimated as necessary to build this railway, has not yet been subscribed; but if Señor Mas is as successful in securing capital from foreign countries as other promoters of electric railways have been, it will only be a short time before the road is in operation.

The People's Telephone and Telegraph Company's Exchange.

A Model Independent Plant at Knoxville, Tennessee.

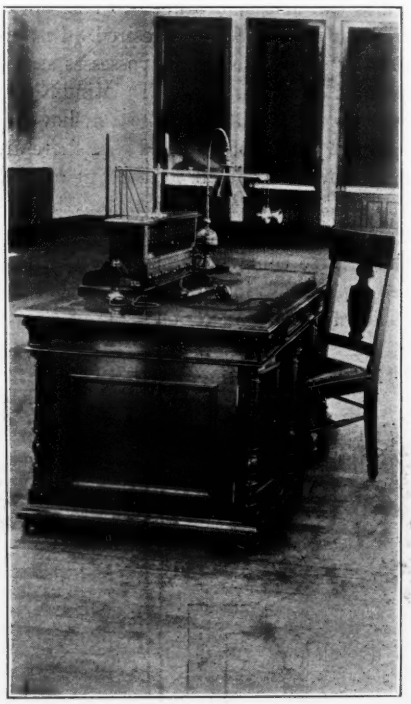
THE TELEPHONE exchange equipment of the People's Telephone and Telegraph Company, of Knoxville, Tenn., represents many model ideas in modern exchange practice. Much attention has been given to detail, and in the architecture and structural design every effort has been made to secure the highest possible degree of satisfaction. The building is of three stories, of stone and brick formation, and the walls are built of such thickness that two stories may be added when the expanding business of the company shall make this desirable. The first floor of the building is laid with a solid concrete flooring, flush with the street, and instead of being given



THE PEOPLE'S TELEPHONE AND TELEGRAPH COMPANY'S EXCHANGE.

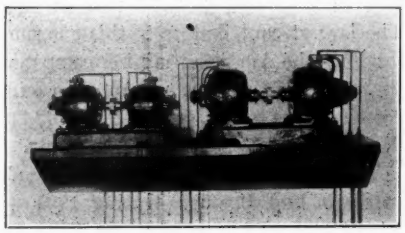
up to offices—as is the usual practice—this is made a storeroom for the reception of cable reels, heavy parts, and all other paraphernalia which at the present or in any future time it might be incumbent upon the company to gather in. The second story contains the offices of the company, situated across the front of the building, and in the rear the cross-board and panel-board are installed. The top story is given up to the main switchboard, taking up the larger portion of the floor. Here is also located the monitor's desk and board, and a very interesting and compact toll-board.

The switchboard is of the standard multiple magneto type, manufactured by L. M. Ericsson & Company, of Stockholm, Sweden, and was installed by the Ericsson Telephone Company, of New York. The present capacity of the board is 1,800 lines, but this can be increased up to an



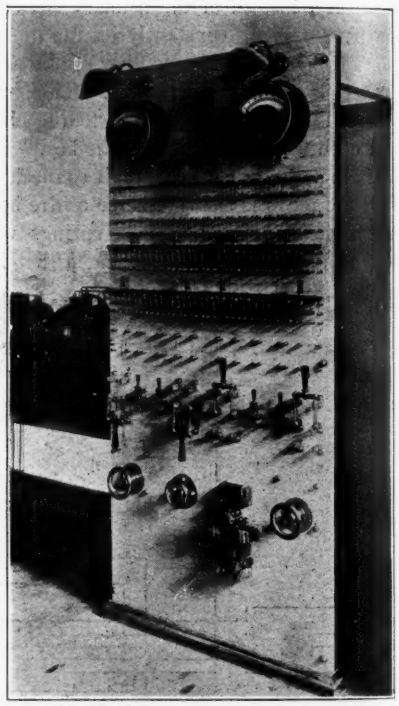
THE MONITOR'S BOARD.

ultimate capacity of 3,500 lines. This board is noteworthy for the excellence with which it has been constructed and the simplicity of detail and facility with which the operating service is carried out. The subscribers' drops are but six inches from the subscribers' jacks, which allows the operator to replace the shutter when



RINGING MACHINE AND BATTERY CHARGER.

the plug is inserted, by simply carrying forward a natural upward movement. The answering and ringing plugs are on two different planes, which prevent any tangling of the cords. An especially desirable feature of this board is in the fact that the cords are in pairs of six different colors—red, blue, green, brown, yellow and drab. In making a disconnection it is not necessary for the operator to trace out the respective cords. After inserting, for instance, a brown cord, she has immediate facility for recovering this cord, thus facilitating the moving of the respective plugs and allowing almost no opportunity for error. The clearing-out drops are restored automatically by the plug being returned to its seat.



THE SWITCHBOARD.

The combination ringing and listening key has but one lever, and a set of auxiliary buttons allows the operator to ring and listen on the separate cords if desired. Automatic counters at each position show the number of outgoing calls, thus allowing the arranging of lines so as to make the work of each operator approximately equal. The listening keys when not in operation are not on the transmitter circuit, and consume battery power only when in use, in this manner considerably cutting down the consumption of energy. The day operators are equipped with breast-plate transmitters and head-gear receivers, but for night service a hand microtelephone is attached to each section of 300 lines, the entire board thus being

handled from six positions. The monitor and toll-boards were also made by L. M. Ericsson & Company.

On the monitor board a visual signal shows whether an operator is busy, and in this manner the monitor is able to revise the work of each operator and distribute the load of business equally among the different attendants. The toll-board is so arranged that by manipulating four plugs both sections may be thrown into one when the business is running light.

The power plant consists of a duplicate set of two cells of storage batteries for operating the switchboard transmitters, night bells, etc., together with the necessary generators and switchboard. The ringing apparatus consists of a motor-generator twin set.

Referring to the illustration, the machine on the left is the ringer, running at one and one-quarter amperes at eighty volts; and that on the right is the battery charger, which runs at seventy-five amperes at six volts. Both of these are operated from the 500-volt circuit. There is also an emergency ringing set, operated by an alternating-current motor which is connected to the lighting circuit.

The instrument on the left is the ammeter, with a seventy-five-volt scale; and that on the right is the voltmeter, with a scale range of fifteen volts. Switches are so arranged that these instruments may be thrown in and register either on the charge or discharge current.

The storage batteries are contained in a cabinet built very much like a refrigerator, and a special flue carries off the gases to the chimney. There are also special inlets for the entry of a current of air to further clarify the atmosphere. Everything is worked by means of this battery.

OPERATING ROOM, PEOPLE'S TELEPHONE AND TELEGRAPH COMPANY, KNOXVILLE, TENN.

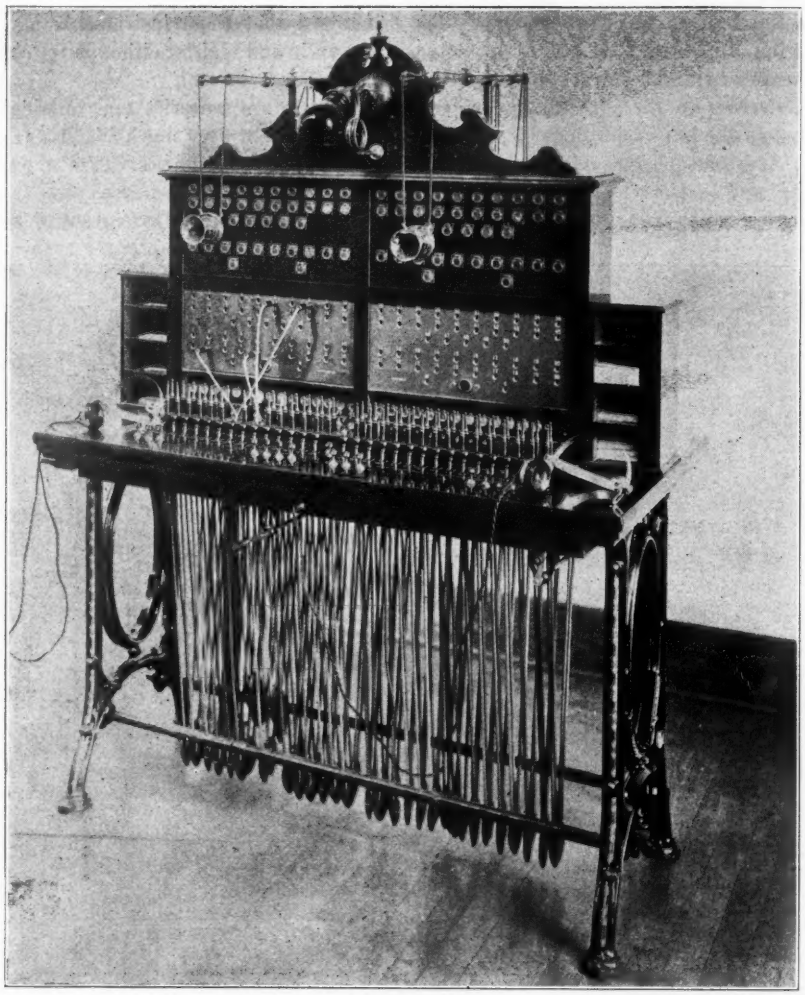
The cross-board is of 2,000 lines capacity at present, and can be extended by sections to the full capacity of the board. The vertical strips of carbon lightning arresters are of 100 lines capacity, and the jumpers are connected to the horizontal connecting strips to which are attached the switchboard cables. This cross-board is fitted with this company's protective device which, when the heat coil (goes down) gives way, automatically opens a spring contact, cutting the line entirely out.

The switchboard is of marble and is equipped with a voltmeter, ammeter, I.-T.-E. circuit-breaker, rheostat and necessary switches. As will be seen in the illustration, each transmitter has a separate switch, this being probably the most positive way of avoiding cross-talk.

The wires of this company are carried underground in tile conduits on the main streets, and enter the building in lead-covered cables, in which they are carried to the second floor, where they are fanned out across the cross-board.

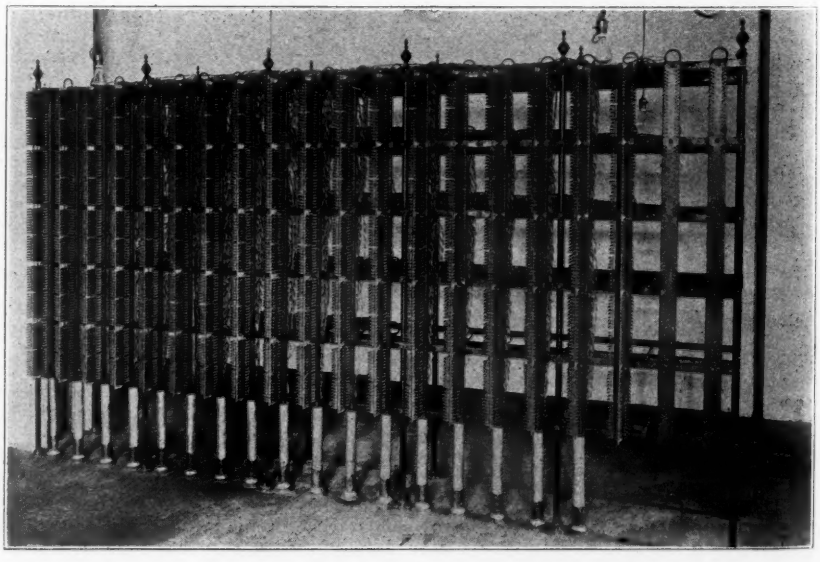
The system is absolutely free from cross-talk, and great credit is due to Mr. J. C. Duncan, the general manager, and his corps of assistants, who have brought

this exchange to its present high state of perfection in equipment and operation. The provisions made for the comfort of the attendants are noteworthy in their completeness. Each attendant has a separate locker, and there is a comfortable reclining and lunch-room fitted with every accessory for the needs of the operators. A further feature is a reading-room and bath.



THE TOLL BOARD OF THE PEOPLE'S TELEPHONE AND TELEGRAPH COMPANY, KNOXVILLE, TENN.

It is interesting to note the complete changes which have been developed in the reconstruction of this exchange. The old exchange at Knoxville, Tenn., was probably one of the most curious, and, it is believed, the only one of its kind which was ever erected. The switchboard of the old exchange consisted essentially of a large round table, at six points of which were pivotally connected different sections of the switchboard. Chairs were placed in position at each switchboard section, and the operators worked around and across the table. A space was provided in the centre of this table, which in the busy time was occupied by an extra operator. This attendant facilitated connections by handing the different plug cords back and forth across the table. At night, when the business was running light, these switchboard sections were swung into place, making practically a small room. This was then a self-contained exchange which one operator took care of from the central position, the drops being replaced by the manipulation of a stick in the hands of the attendant.



CROSS-BOARD, PEOPLE'S TELEPHONE AND TELEGRAPH COMPANY, KNOXVILLE, TENN.

THE MAGNITUDE OF TELEPHONE COMPETITION.

BY FRED DE LAND.

Very few among the 2,000,000 telephone users in the United States realize how tremendous are the odds against which Independent telephone men are bravely battling, or the magnitude of the investments involved, and probably many Independents have but slight conception of the true state of affairs. But there is one Independent who comprehended from the beginning what a masterly foe the Independents had to fight, and he touched upon the resourceful qualities of the enemy near the close of the banquet following the National convention held in Chicago in 1899. Then, at the National convention held in Buffalo last summer, this same aggressive but intelligent and broadminded Independent, the Hon. Harry D. Critchfield, told the delegates that he did not "mean to underestimate the strength of the opposition. I want to impress upon you that it is a good deal hotter now; that it is in better shape to give us a run for our money now than it has ever been before, but we are in shape to get our money's worth; but it is yet unfinished; we have yet to be vigilant and watchful."

Mr. Critchfield's remarks have always attracted wide attention, both by reason of his thorough grasp of the subject and of his high official connection with the National association from its inception and his position as general counsel for the Everett-Moore companies. Hence, it is worth while for Independents to estimate the strength of this resourceful enemy and endeavor to ascertain what inroads have been made on its resources since the last

National meeting, as shown in statistics gathered from annual reports of Bell companies as published each spring in the ELECTRICAL REVIEW.

Table No. 1 shows the net increase in Bell service during the past twenty years. It will be observed that the average net yearly growth during the thirteen years, from 1882 to 1894, inclusive, was only 384,230. That is, in the two years ending December 31, 1901, there was a greater net gain in Bell telephone stations than the total number in service at the expiration of the twenty years ending December, 1897.

To more readily comprehend the magnitude of this present increase in telephone stations, the exact growth as given

TABLE NO. 1.

Bell telephone statistics as recorded December 31, 1901.

Year.	Bell Exchanges.	Branch Offices.	Telephone Stations.	Bell Employés.
1882	725	345	97,728	3,716
1883	906	419	123,625	4,762
1884	772	481	134,847	5,168
1885	747	428	137,750	5,438
1886	736	446	147,068	5,843
1887	739	452	158,712	6,183
1888	742	452	171,454	6,310
1889	757	774	185,003	6,758
1890	774	467	202,931	7,845
1891	788	509	216,017	8,376
1892	812	539	232,140	9,970
1893	838	571	237,186	10,421
1894	867	572	243,432	11,094
1895	927	686	281,695	11,9a0
1896	967	832	325,244	14,425
1897	1,025	937	384,230	16,682
1898	1,126	1,008	465,180	19,668
1899	1,239	1,187	632,946	25,741
1900	1,348	1,427	800,880	32,837
1901	1,411	1,594	1,020,647	40,864

11,208, and the total net increase only 145,714 for the same period, or a total far smaller than the net increase in the single year 1899, when a net gain of 167,934 stations is reported.

The last annual report of the parent Bell company shows that on January 1, 1893, the year the fundamental Bell telephone patent expired, there was a total of 232,140 telephone stations or exchange subscribers in service, while on December 31, 1901, there were 1,020,647 telephone stations in service. That is, the total number of Bell subscribers increased during these ten years from 232,140 to 1,020,647, a gain of 888,507, or of 377 per cent. Standing out by itself this percentage is large, and is not small when divided by 10, the number of years embraced in the report. But how insignificant appears the yearly growth prior to the year 1899 when compared with the recorded growth since last year. That is, comparing the growth of the last four years with the previous six years. For instance, the actual net gain in Bell telephone stations during the year 1901 was 219,767. That is, the yearly net increase in telephone stations for the year 1901 almost equaled the entire number of telephone stations in service on December 31, 1892, namely, 232,140, or a relative net gain of 94 per cent per annum. While the total net gain in Bell telephone stations during the two years, 1900 and 1901, was 387,701, or a net gain far greater than all the telephone stations in operation on December 31, 1897, namely,

in the annual report is shown in table No. 2.

Now the average rate of net increase for the past four years has been 28 per cent, while for the first four years, shown in this report, it averaged only 9 per cent. If the rate of the net increase during the next four years should be only 25 per cent it would ensure 2,000,000 telephone stations in service on December 21, 1904, or one telephone station to each forty of

TABLE NO. 2.

Showing increase in Bell subscribers.

December 31.	Total Stations.	Annual Increase.	Per Cent of Increase.
1889	185,003	13,549	8
1890	202,931	17,928	10
1891	216,017	13,086	6
1892	232,140	26,123	13
1893	237,186	5,046	2
1894	243,432	6,246	3
1895	281,695	38,263	16
1896	325,244	43,549	15
1897	384,230	58,986	18
1898	465,180	30,950	21
1899	632,946	107,766	26
1900	800,880	167,934	27
1901	1,020,647	219,767	27

population on a basis of 80,000,000 in the United States only. And this refers only to Bell telephones.

That annual report also shows that "at the end of 1901 there were nearly 900,000 Bell telephone stations which could be connected to the long-distance system, and, consequently, to each other, a gain of about 180,000 for the year. At the end of 1898 there were only about 400,000 which could be so connected." In other words, "nearly 900,000," or 85 per cent, of all Bell subscribers can talk to one another, if they so desire, in the territory between "nearly all the important cities on the Atlantic seaboard throughout the country as far west as St. Paul, Minneapolis, Omaha, Kansas City, Little Rock and New Orleans."

The financial condition of the parent Bell company is outlined in table No. 3, and serves as a voucher to the accuracy of Mr. Critchfield's public statement that the Bell "is in better shape to give us a run for our money now than it has ever been before," a statement that is even more strongly endorsed in the facts shown in table No. 4, which is a compilation of the amounts the Bell licensee companies have expended yearly in new construction.

The total amount expended by the Bell interests prior to 1902 for construction and equipment and for the real estate necessary for exchanges and offices is $199,574,517.83, in addition to the sum of $19,116,209.40 invested by the long-distance system in line construction, equipment and supplies. As the bonded debt is less than 7 per cent of the amount actually expended in new construction, it is evident that the Bell properties are not being developed on borrowed money, but by cash advanced by the stockholders, new capital invested as rapidly as conditions permit, in the belief that such investment is amply secured by tangible assets and earning capacity. And no stronger proof of the permanency, stability and continued growth and prosperity of this powerful competitor should be desired.

The estimation the Bell has placed upon the Independent movement is shown in the following extract from the last annual report of the parent company:

Competition from telephone companies not associated with this company has existed for several years, and is likely to continue in some places for some time to come. While it has in some localities affected the licensees of this company disadvantageously by reducing, for a time at least, the number of their subscribers and forcing them to meet competition rates that are not based upon a proper recognition of the cost of doing the business or an adequate appreciation of the amount that should be set aside from earnings for maintenance, reconstruction and depreciation, the consequences of the competition to the business as a whole have not been of serious moment. The public in each community will determine for itself whether it is for

its advantage that there should be two telephone exchanges serving one body of people. It would seem as if but one conclusion on this point was possible. In any event, the comprehensive character of the system of this company and its licensees, organized as the system is to afford uniform and adequate telephonic intercommunication throughout the country, and the intention and ability of the company and its licensees to give good service at fair rates, must ensure the permanency and prosperity of their business in the future as in the past.

TABLE NO. 3.

Financial data from records of parent Bell company.

Year.	Capital Issued.	Dividends Paid.	Bonds.	Surplus.	Reserve.	Contingent.
1880	$7,350,000	$178,500				
1881	7,355,000	416,500				
1882	7,350,000	595,000		Not recorded in journals available.		
1883	9,602,000	1,051,479				
1884	9,602,000	1,440,315				
1885	9,802,100	1,562,236				
1886	9,802,100	1,568,336	.....	$1,491,380	.....	.....
1887	9,802,100	1,568,336	.....	2,028,036	.....	$8,554,752
1888	9,962,100	1,789,878	.....	2,028,036	.....	.....
1889	11,303,900	1,838,913	.....	.....	.....	.....
1890	12,500,000	2,213,913	$2,000,000	2,151,012	$2,489,013	10,516,545
1891	15,000,000	2,625,000	2,000,000	2,151,012	2,986,867	10,274,913
1892	17,500,000	2,919,080	2,000,000	2,151,012	3,357,723	10,169,925
1893	20,000,000	3,339,156	2,000,000	2,151,012	4,191,013	10,137,493
1894	20,000,000	3,000,000	2,000,000	2,151,012	4,222,757	10,228,571
1895	20,000,000	3,339,156	2,000,000	2,151,012	4,191,013	12,713,800
1896	27,211,200	3,361,183	2,000,000	2,151,012	4,035,400	12,397,621
1897	31,996,882	3,682,949	2,000,000	2,590,521	4,025,628	12,399,047
1898	31,996,882	4,883,945	5,049,000	2,785,074	4,499,559	12,399,147
1899	31,996,882	4,882,945	10,007,500	2,975,078	4,928,513	12,345,975
1900	89,100,500	4,078,601	10,006,000	1,813,200	2,416,363	15,970,210
1901	104,650,600	5,050,024	15,004,500	2,764,669	4,047,477	15,970,210

The estimate placed upon Bell competition by an Independent engineer, Mr. Arthur V. Abbott, reads as follows:

"The inception and perpetuation of an enterprise to operate over this entire continent, necessitating business relations of the most heterogeneous character, required the exhibition of the keenest skill and shrewdness in the manipulation of men, and possessed the greatest advantages in uniformity, strength and coherence. Quite possibly, under any other form of organization, American telephonic development would be far behind what it is to-day, for it can not be denied that the Bell system is a most magnificent masterpiece, both of business and technical engineering."

Mr. Critchfield also told the delegates to the Buffalo meeting that "it has been said that the condition on which Mr. Fish accepted the presidency of the American Telephone and Telegraph Company (the parent Bell company) was that the policy of the company should be changed as that connection might be made between the Bell companies and Independent properties when the Independent companies had the best of the situation."

Two weeks after the Buffalo meeting the Mr. Fish referred to by Mr. Critchfield took up the duties devolving upon the chief executive of the parent Bell organization and, hence, will have been in office nearly a year when the National convention meets in Philadelphia. Regarding his work and attitude the electrical and daily press states that "a new policy is in force," that it implies a complete change in official instructions from the Boston office, and a pronounced determination on the part of the new Bell management to win and to hold the good will and continued patronage of the telephone-using public if high-class service and an earnest study of the ever-changing needs of both small and large users of telephone service can merit support. It further implies the highest improvement possible in each branch of traffic, and thereby gradually bringing about the ultimate elimination of competition by supplying a service so comprehensive and so excellent in character "that the public will determine for itself, whether it is for its advantage that there should be two telephone exchanges serving one body of people," as Mr. Fish has publicly stated.

This new policy is also said to imply a gradual reduction in the number of Bell licensees, and that all licensee companies will be governed directly by this new broad Bostonian policy to the end that uniform methods of treating the public generously and fairly may prevail throughout the United States, and of so treating competition that the action of one licensee company may not react disastrously on another licensee. Now these licensee companies, under the guidance of their new commander, will soon be likened to forty well-trained, well-disciplined and richly equipped brigades having an apparently unlimited supply of ammunition in the form of cash for extensions and cheered on to renewed effort by the ceaseless demand for telephones and the preparations for merging into one mighty army.

The press also tells that the commander of these forty brigades is a big man in the broadest, most generous sense, a typical twentieth century successful man of affairs, formerly a leading counsel for many large corporations as well as "the undoubted leader of the patent bar of the United States," and a man who is said to have won his present high position by the masterly manner in which he straightened out the affairs of the General Electric Company and sent it spinning along the highway to prosperity.

It is claimed that the attitude of Mr. Fish toward all Independents partakes of the same generous character as Grant exhibited to Lee and Lee's army under the apple tree at Appomattox, hence Independents are saying that "he is a most difficult character to down." For everywhere Mr. Fish is said to be leaving the impression that the dominating thoughts that govern all his movements are "satisfied subscribers" and "public welfare," and not "public discomfort" and "extermination of competition" in the matter of telephone service.

TABLE NO. 4.

Showing amounts expended each year in new Bell construction only.
(Not including expenditures by long-distance system.)

Year.	New Exchange Construction and Equipment.	Real Estate and Buildings for Local Exchanges and Offices.	New Toll Line Construction.
1894	$4,138,000	$411,000	
1895	6,463,000	465,000	Not shown in electrical journals.
1896	8,275,929	1,160,924	
1897	4,865,317	1,484,332	$3,847,396
1898	7,477,496	1,107,286	4,658,426
1899	15,949,463	2,066,311	8,087,359
1900	21,914,542	2,849,103	6,948,427
1901	22,100,000	1,750,000	7,250,000

(The foregoing does not include expenditures for maintenance and repairs, which have exceeded the amounts expended for new construction. For instance, during 1895, "the companies expended for repairs and construction $7,223,000.")

LONG-DISTANCE SYSTEM.

The total expenditure on account of the long-distance system for new construction is reported at the close of each year as follows:

To December 31, 1893, $6,433,150
To December 31, 1894, 7,460,633
To December 31, 1895, 11,435,055
To December 31, 1896, 13,187,300
To December 31, 1897, 13,888,152
To December 31, 1898, $14,847,589
To December 31, 1899, 15,118,509
To December 31, 1900, 16,152,021
To December 31, 1901, 19,116,209

Facing so powerful a competitor, is it wise for Independents to longer ignore the practical and valuable advice given by Senator Kline at the Cleveland convention? "We must always remember that we have a strongly entrenched opponent to fight, and we can not afford to carry on a guerrilla warfare among ourselves or fritter away our strength in little difficulties that can easily be harmonized."

A STUDY OF THE HEATING OF RAILWAY MOTORS—I.*

BY A. H. ARMSTRONG.

The electric traction problem presents many new features for investigation which are not met with in steam railroading, and upon which little accurate data have been published. This is especially true of that class of service calling for maximum

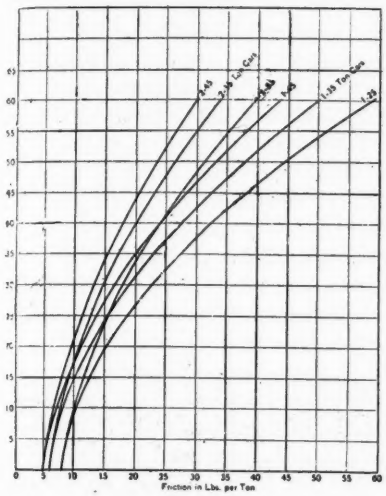


FIG. 1.

speeds greater than 35 or 40 m. p. h., where stops are infrequent and cars are run singly or in trains of two cars or more. It is the purpose of this paper to enter into a discussion of some of the variables met with and their influence upon the motive power and station output for the higher as well as lower speed schedules.

The electrical engineer has to take care of two factors with which the steam engineer is unacquainted, keeping the temperature of the motive power within reasonable limits and also the operation of single cars at maximum speeds of 60 to 70 m. p. h. That wind friction is a considerable factor with trains operating at high speeds has been abundantly proved by many tests, but these tests are worthless when used to determine the power required to propel a single car at the same high speeds. As the electric motor has invaded the high-speed interurban field and has done so successfully because of the frequency of service furnished with single car trains, it becomes pertinent to enquire into the size of the motive power necessary to prevent overheating and also the amount needed with the high-speed schedules and frequent stops made.

Regarding the tractive effort required to propel trains of one or two cars at speeds of 60 m. p. h. or more, there is almost a complete lack of experimental data. Formulæ based upon tests of steam trains made up of a number of heavy coaches can not be applied with any accuracy to the operation of single car units. A series of tests made by the General Electric Company on the Buffalo and Lockport tracks, with trains of different sizes, provides almost the only data upon which to base such calculations. These tests were carried up to speeds approaching 60 m.p.h. with ordinary steam railway coaches, hauled by a 38-ton electric locomotive. The cars were not vestibuled and the conditions were not, therefore, such as to give results directly applicable to the operation of single suburban cars of the vestibule type. For want of more accurate data, these tests will be used as the basis of the following calculations, and, as the curves deduced are used for comparison only, it makes little difference if the friction values are not absolutely correct. These train friction tests were published in the May issue of the *Street Railway Journal* by Mr. W. J. Davis, Jr., and for convenience of reference some of the curves are here reproduced as Fig. 1.

The tendency of the electric roads has been toward heavier cars, especially on the higher speed lines, where the car weights run from 25 to 45 tons, including equip-

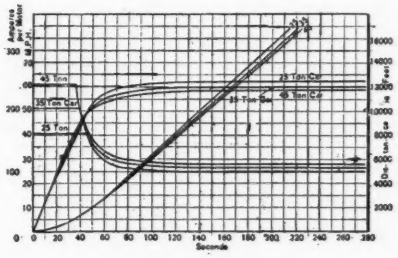


FIG. 2.

ment and seated passenger load. Suppose we equip cars weighing 25, 35 and 45 tons with the same four-motor equipment, geared for 60 m. p. h. with the 35-ton car, there would then result speed time-curves as in Fig. 2, the speed curve of the 45-ton car falling below and that of the 25-ton car rising above that of the 35-ton car for the same gear ratio. A tractive effort of 120 pounds per ton gross has been taken with all three equipments, as representing average conditions for this class of work, giving a net acceleration of about 1.06 m. p. h. per second, after deducting friction loss and the power required to accelerate the revolving parts. Any other rate of acceleration could have been taken with little or no effect upon the heating of the motive power or its energy consumption, as will be shown later, the larger part of the energy input being used up in overcoming air resistance at this high speed.

Speed and amperes input are plotted as ordinates with time as abscissa and power may be shut off at any time, the car allowed to coast and brought to rest by brakes, making the enclosed area of the speed time-curve proportional to the distance covered, and the area of the ampere time-curve equals the ampere hours input. For the sake of simplicity it has been assumed that the friction will be the same at the same speeds during acceleration and coasting; that is, that the energy given up by the rotating parts during coasting will equal the gear and friction loss of the motors running light, an assumption which is approximately correct. The coasting curve will, therefore, follow the shape of the friction curves in Fig. 1, will be curved and show a greater retardation at high than at low speeds.

While power is applied, the motive power has internal losses, varying not only in intensity but in their distribution. At zero speed, the losses are all in the copper of field and armature, being divided according to their relative resistances, but as the armature speed increases there is an iron loss distributed between the iron of armature and pole-face and tips, depending upon the design of the motor. This iron loss starts from zero at standstill and increases to a maximum at the moment of cutting out starting resistances, after which it falls off somewhat, but this again is a matter of motor design. As these various losses are the cause of our motive power heating, it is necessary to trace their influence upon the individual parts of the motor under study.

As the heating of a motor is the result of the average losses within it, the average losses and their distribution up to any

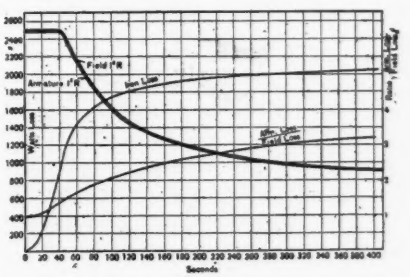


FIG. 3.

moment of shutting off power must be determined. Such losses are shown in Fig. 3 for our 35-ton car equipment, speed and ampere curves of which are shown in Fig. 2. The motor losses for 25 and 45-ton cars have been left off to avoid confusion, but from the shape of the ampere time-curve in Fig. 2 it is evident

* A paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers, Great Barrington, Mass., June 19, 1902.

that the curves will vary greatly from those shown only during the fractional speed or acceleration period, these differences being virtually wiped out with a considerable amount of running upon the motor curve. Thus, while there is a total average copper loss of 5,000 watts during acceleration upon resistance, the copper loss curve becomes flat in about 400 seconds at the value of 1,800 watts in the copper, with the motor constants chosen. As an equipment geared for a maximum speed of 60 m. p. h. would hardly be used for an average run of less than 15,000 feet, requiring power on for fully 160 seconds for its accomplishment, it will be seen that the acceleration losses play a comparatively unimportant part in very high speed work, so far as the motor heating is concerned. That this is not true of low speed work will be discussed later.

The iron loss has been assumed to be dissipated entirely from the armature in arriving at the "ratio of losses" in Fig. 3. This is not strictly true, but the true subdivision of losses, whatever it may be, will be practically the same with the same "ratio of losses," and hence any values of motor heating deduced from curves similar to Fig. 3 must be consistent. For example, if we know the degrees rise per watt loss for field and armature with any given "ratio of losses," the temperature arrived at would be correct, provided the temperature constants were obtained from experimental runs where the motor went through the same cycle as in the run to be determined.

Suppose we take our motor equipment, place it upon a car and run it over a measured length of level track, keeping an accurate record of the current input and voltage per motor at each instant. Then let this sample run be repeated successively for a period of ten hours, or long enough for the motor temperatures to have reached their maximum, and we have the relation between energy lost in the motor and its temperatures for a given set of conditions. Vary the length of the test run and repeat the 10-hour test and we have another relation between temperature rise and energy loss for another set of conditions. It is evident that a series of such tests taken on a given type of motor would give material from which the relation between its internal losses and temperature rise would be known for any set of conditions, and, moreover, these values could be used directly in calculations for any given service as they were obtained under operative conditions, and need no constant applied to make them approximately correct for service conditions.

It may be urged that it is difficult to reproduce with any accuracy the sample run agreed upon, or that it is difficult to follow through and keep an accurate record of just what takes place in the motor during its cycle of operation. If

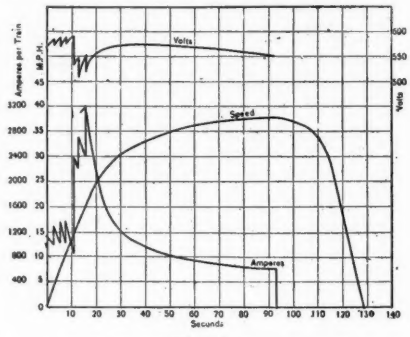


FIG. 4.

necessary, an automatic device for applying the current could be used, such as a motor to throw on the controller at a predetermined speed. Sufficiently good results can be obtained, however, by ordinary hand control with a trained operator, while sample runs taken every few minutes by recording instruments serve as a check and furnish the material upon which to base the motor's performance during the test.

A sample set of curves of such a test is shown in Fig. 4 indicating voltage, amperes and speed upon a time basis, all taken by recording instruments. The voltage indicated is that between third rail and ground, but the motor voltage during running upon resistance may be taken as proportional to its full internal voltage at the moment of cutting out final

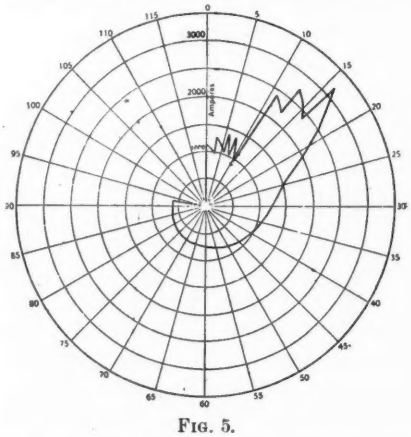


FIG. 5.

starting resistance without making any appreciable error in arriving at iron loss values. The ampere curves give the means of determining the copper losses by plotting on polar coordinates as in Fig. 5, and determining the area by planimeter, giving directly the square root of mean square value. Both Fig. 4 and Fig. 5 show curves produced by a recording instrument placed directly in the main circuit of the car, thus giving the series parallel effect of the motors so connected. In our motor calculations we are concerned with the amperes per motor which will be independent of the series parallel control. The curves in Fig. 4 and Fig. 5, however, are shown simply to demonstrate the accuracy of the recording instrument, and while Fig. 5 could not be used directly to determine the square root of mean square current per motor, it shows the method used in determining this constant.

It will be seen that by using recording instruments and by taking a sufficiently large number of curves, it is possible to determine very accurately the average losses dissipated as heat by the motor during the test run, and also ascertain the distribution of these losses in the several parts of the motor. The motor ventilation is the same as in a service run; it is operated at varying speeds, remains at rest the required proportion of the total cycle, and in every way the average conditions pertaining to a service run are reproduced in the test run, thus making the data so obtained directly applicable to service problems without the use of any constant.

A curve showing the results of a number of such tests is given in Fig. 6, indicating the degrees rise per watt loss in field copper and in armature with any relation between total armature and field loss. Here, also, the total iron loss is assumed to be in the armature, and this loss, added to that of the armature copper, gives its total loss, used in determining the "ratio of losses."

Taking up again the study of the motors mounted upon the 25, 35 and 45-ton cars, we are now in a position to apply the motor losses obtained in Fig. 3 with the 35-ton car, and similar curves with the 25 and 45-ton cars. By completing the cycle in Fig. 2 and bringing the car to rest in any given distance, the time of shutting off power can be determined, the average losses and their distribution ascertained by curves in Fig. 3, and the temperature rise found out by applying the constants in Fig. 6. That is, for any given schedule we can determine the temperature rise of field and armature for the three-car train weights and the given gear ratio assumed. By plotting a sufficient number of schedules, a curve similar to Fig. 7 will result, which affords a very interesting study.

Such a curve in lieu of a better name might be termed a "service capacity

curve" of the General Electric "H" motor. It shows the temperature rise per motor for any weight of car and the schedule that can be performed with the gear ratio chosen, all plotted in terms of the number of stops per mile. The temperature rise is given as that of the hottest part, whichever it may be. The schedule includes stops lasting fifteen seconds each. Acceleration is the result of a constant tractive effort of 120 pounds per ton during resistance running, and braking is effected at the rate of 150 pounds per ton. Coasting is assumed to continue 10 per cent of the duration of the running cycle. Curves of higher temperature can not be completed without greatly exceeding the commutation limit during acceleration, but would reverse and approach zero the same as those of lower temperature for infrequent stops.

The relation between train weight and temperature rise for a given schedule and frequency of stops is instructive. With one stop per mile and five tons weight per

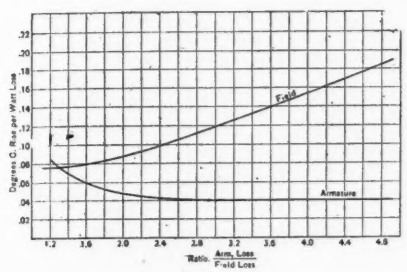


FIG. 6.

motor, a temperature rise of 54 degrees is noted, while 10 tons per motor increases the temperature to 120 degrees rise. That is, the motor temperature increases faster than proportionally to the increase in train weight, due, as we should expect, to copper losses increasing as the square of current; but our friction curves indicate a much larger friction in pounds per ton for the lighter weight cars, thus bringing the accelerating current required to propel a car at 60 m. p. h. to about that required for cars varying considerably in weight. We would expect, therefore, that for continued runs where the losses due to acceleration are subordinated to the running losses, this increase in temperature with increased car weight would not be so marked. That such is the case is shown by comparing temperatures in the case of train weights of five and ten tons per motor with more infrequent stops, say one stop in four miles, giving temperature rises of 72 degrees and 98 degrees, respectively, for the same schedule of 48 m. p. h. The curve for 80 degrees rise is very curious, as it indicates a constant weight train with our equipment, regardless of the frequency of stops, while higher temperatures increase and lower temperatures decrease the train weight with the infrequency of stops. The percentage of the time that motors are operating upon start-

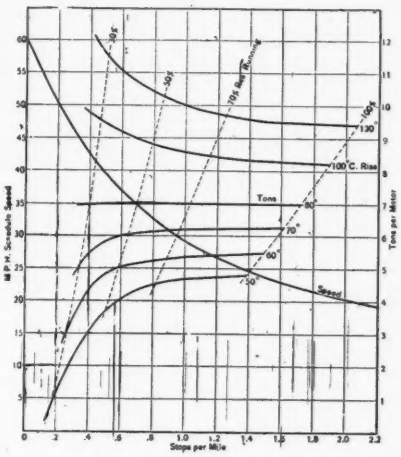


FIG. 7.

ing resistances is indicated by dotted lines.

Curves shown in Fig. 7 are all based upon the same gross tractive effect, giving practically the same rate of acceleration. It is evident that the same schedules could have been made with innumerable other accelerating rates, coasting less with the slower and more with the more rapid rates. In order to make our study of the "H" motor more complete, two sets of curves similar to Fig. 7 were plotted, the first with an accelerating rate of 90 pounds per ton gross and 10 per cent coasting, and the second with 120 pounds per ton and 25 per cent coasting, both making the same schedule with the same frequency of stops. The com-

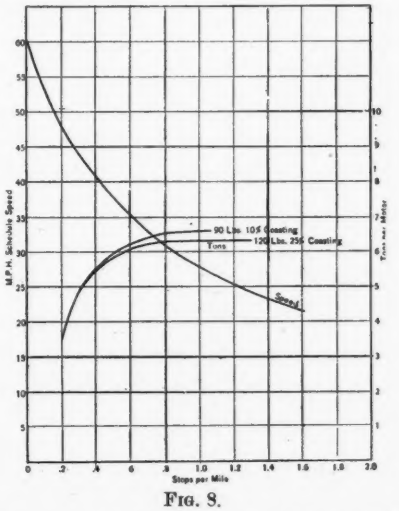


FIG. 8.

parison of these two curves is shown in Fig. 8, plotted for a temperature rise of 60 degrees only in order to avoid confusion. The lower rate and less coasting has some advantage for more frequent stops, but as such an equipment would not be used geared for 60 m. p. h. with much less than a two-mile run average, it follows that the temperature rise would be virtually the same with either rate of acceleration.

Lower speed equipments, however, present results differing from this, as is shown in Fig. 9, illustrating the 60-degree rise curve for a maximum speed equipment of 30 m. p. h. Here 160 pounds and twenty-five per cent coasting contrast very favorably with 120 pounds and 110 per cent coasting. In other words, the motor capacity is greatly increased by raising and accelerating rate while still maintaining the same schedule and frequency of stops. Increasing the accelerating rate does not necessarily mean going beyond the commutating limit of our motors, as a lower speed gearing can increase the rate of acceleration with the same current flowing in the motors as with the slower rate of a higher speed gearing.

A study of the foregoing curves seems

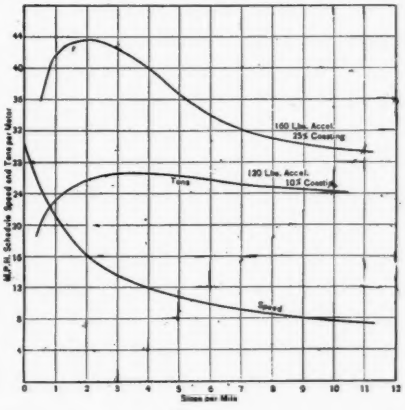


FIG. 9.

to indicate that so far as motor heating is concerned, it is preferable to use the largest gear ratio and highest rate of acceleration possible for the accomplishment of the service contemplated, provided the maximum speeds are low, but that practically any rational rate of acceleration can be used where speeds approach a maximum of 60 m. p. h. As will be shown later, the energy consumption is less for a higher rate of acceleration permitting more coasting, but unfortunately the fluctuations on the distribution system and the load curve on the generating station may both be much poorer if the accelerating rate is carried too high and the number of units in service is small. In the choice of gear ratio for a given service, therefore, not only must account be taken of the question of motor heating with different rates of acceleration, but due heed must be paid to the question of line fluctuations, station load and energy input. It may be possible that what is gained in car energy by a more rapid acceleration may be lost by the poorer coal economy resulting from a more irregular load curve upon the generating station.

(To be continued.)

Canadian Electrical Association.

Proceedings and Discussions at the Twelfth Convention, Held in Quebec.

THE CONVENTION was called to order by the president, Mr. P. G. Gossler, of Montreal, on Wednesday, June 11, at 10.15 A. M., and continued in session until Friday, June 13.

The officers of the association present were: First vice-president, B. F. Reesor, Lindsay, Ontario; second vice-president, Edward Slade, Quebec; secretary-treasurer, C. H. Mortimer, Toronto, together with the following members of the executive committee: Messrs. J. J. Wright, manager, Toronto; John Yule, Guelph, Ontario; Ormand Higman, A. A. Dion, Ottawa; A. Sangster, Sherbrooke; George U. G. Holman, Quebec, and K. B. Thornton, Montreal, Quebec.

The local committee which looked after the welfare of the convention and helped to make it a success were Messrs. Edward Slade, G. U. G. Holman, Louis Burran, A. R. Henry, Ed A. Evans, Ed Blair, J. S. Bosse and A. Dodge.

On behalf of the city of Quebec Alderman Tanguay welcomed the convention and hoped their stay in Quebec would be very pleasant and profitable to the delegates. Mr. A. A. Dion, on behalf of the convention, responded in a few well-chosen words.

The president delivered the annual address which was listened to with very great attention. He said it was particularly appropriate that they should meet in the historic city of Quebec, which was so early associated with the development of electrical power transmission, the development and operation of water-power plants for electrical transmission having been greatly encouraged in its early stages by the successful utilization of Montmorency Falls for lighting and power purposes. He spoke with pride of the sound and healthy condition of the association, the steadily increasing membership giving evidence of the life and vitality of the association. He thought within a short time every company or person interested in electrical pursuits and industries would be represented on the roll of membership. He wished to emphasize that this association wanted and required the cooperation and assistance of the manufacturers. A handsome donation had been made to the association which would be set aside and a yearly sum allotted for prizes for papers presented at the annual conventions. While no legislation had been enacted during the past year, yet there was an undercurrent tending toward legislation which would deprive many existing companies and much invested capital of their legitimate rights and protection; that under the Conmee Act during the past year certain evidence had been given in arbitration proceedings which could not do otherwise than have a tendency to depreciate the value of plants below the point which would be approved of by this association. It was therefore the duty of the association to promote the interests of its members and discountenance and discredit such publicly expressed opinions as had a tendency to put other than a fair value on the properties of electrical companies. He called especial attention to an effort on the part of one of the largest cities in Canada by the Board of Fire Underwriters to force upon the city the expense and responsibility of establishing a system of inspection for electrical installations. He said largely in the United States and, to a limited extent, in Canada it had been found advantageous to the boards of fire underwriters to establish bureaus of inspection of their own and maintain them at their own expense. He was strongly of opinion this was the better way. The expansion of the business of electric companies during the past few years had never been equaled in the same time in any other industry. The president depreciated the policy of some companies which, in their efforts to get business, did so regardless of the price at which they procured it. In conclusion, he thanked the association for the support given him during the past year, and said it would always give him pleasure to do anything in his power for the association.

The secretary-treasurer's report, showing a standing membership of 306 with a gain since the last report of thirty-nine, was presented.

The report of the legislative committee was presented by the chairman, Mr. John Yule, in which it was suggested that owing to the fact that the agitation for municipal control having developed into a socialistic propaganda of a far-reaching nature it would be a wise thing for the companies interested to give a more active and liberal financial support to this association if they at all valued what had been already accomplished in their interests.

Alderman Sadler presented the report of the committee to confer with the Board of Fire Underwriters. The report stated that there could be no question of the advisability of having an inspector on electric wiring, but that it should be divided into two classes, that pertaining to wiring done outside, on and over the roofs of public buildings, and, secondly, the wiring inside of buildings. The Board of Fire Underwriters had been doing something for their own protection, and there was no reason why this should not be continued, the question of expense being settled between themselves and the parties they were inspecting for.

This report elicited considerable discussion, many of the visitors from the United States taking part in it, but without arriving at anything definite. The report was received and adopted and the committee continued.

The report of the Committee on the Standardization of Accounts was read by Mr. A. A. Wright, of Renfrew.

The president appointed Messrs. J. J. Wright and K. B. Thornton as a committee to arrange the standing committees for the year.

On Wednesday afternoon special cars left the Chateau Frontenac to pay a visit to the substations of the Quebec-Jacques Cartier Electric Company and the Quebec Railway, Light and Power Company, and on arriving at the carsheds of the Quebec Railway, Light and Power Company, Mr. A. B. Lambe, of Toronto, presented a paper on "The Electrical Equipment of an Ordinary Street Car." This paper, while necessarily elementary, was of an interesting nature to those present. At the close a hearty vote of thanks was tendered for the exceedingly interesting address.

On the same evening, at eight o'clock, a paper was read by Mr. W. D'A. Ryan, of Lynn, Mass., on "The Development of Arc Lighting Apparatus from 1810 to 1902," with special reference to modern arc lighting engineering.

As will be seen by the title of this paper, it was somewhat historical in the opening, but became extremely practical at its close. Mr. Ryan illustrated his lecture by means of cuts, sketches and diagrams projected upon a screen. His lecture concluded with a dissertation on direct-current *versus* alternating enclosed arc lamps, which may be summed up as follows:

1. Open arcs give a higher maximum candle-power than enclosed arcs of corresponding wattage, but the maximum candle-power is in an undesirable direction, and the light fluctuates through very wide limits. Enclosed arcs give a higher candle-power through the most useful angles from three degrees to ten degrees below the horizontal. The light from the enclosed arc is more uniform and steadier, and generally superior from an illuminating point of view to the open arc.

2. Direct-current enclosed arcs produce slightly higher candle-power than alternating enclosed arcs of corresponding wattage, but so far as illuminating value is concerned, the two lamps are, generally speaking, on a fair basis of equality, both being superior to the direct-current open arc.

3. Opal enclosing and clear outer globes will light relatively further than any other combination.

4. Small unit arcs will illuminate proportionately greater distances than large units for a given expenditure of energy.

5. Incandescent lamps do not illumi-

nate brilliantly to a sufficient height above the street surface to produce the effect of good lighting and are therefore not comparable with arc lights.

Mr. Spalding, of the National Electric Improvement Company, of New York, explained to the members the two-pin lamp, called the Elblight, used for decorating, signs, etc.

The Bullock Electric Manufacturing Company, of Cincinnati, Ohio, had printed daily for distribution a registration folder containing the name of each person in attendance at the convention, numbered consecutively, and presenting each of the persons whose names appeared in the folder with a button containing a number corresponding with that opposite the name in the folder.

On Thursday morning papers were presented by Mr. C. M. Greene, Lynn, Mass., on "Arc Lighting," and by Mr. Percy H. Thomas, Pittsburg, Pa., on "Lightning Protection and the Static Interrupter." Mr. Greene's paper dealt with the classification of arcs, arc characteristics, candle-power and arc efficiency, supply systems and types of lamps, generating apparatus, the constant-current series alternating system of arc lighting, multi-circuit series arc lighting system and plant efficiencies and losses. This paper was a very able and interesting one, and brought forth considerable discussion, and the conclusions arrived at were that the enclosed arc was better and cheaper to operate than the open arc; the direct constant-current enclosed arc system the best and most economical for plants devoted exclusively to arc lighting; the alternating constant-current enclosed arc system the best and most economical for plants which use large 40 to 125-cycle alternating-current generators, the arc lamp load being a small part of the total output of the station, and that constant-potential direct and alternating-current arc lamps were very extensively used on constant-potential systems of distribution for inside lighting, and somewhat for street lighting, but only when there are special reasons for so doing.

Mr. Thomas's paper was one of the most instructive of the papers presented at the convention and was illustrated by a unique working model devised by the author of the paper. To summarize:

The usual result of a lightning stroke in the neighborhood of an electric current was the production of secondary static waves traveling along the circuit away from the locality of the discharge. When one of these waves encountered a transformer or generator coil, the potential of the terminal is suddenly raised and while the charging current is flowing to the inner turns of the winding the potential of this wave will be impressed upon the outer turns alone, which may thus be subjected to a strain very many times greater than that normally impressed upon them. The suddenness of these static waves being that which makes them harmful in their effect, which is especially characteristic of lightning.

Grounds in windings, as well as short-circuits, may be caused by the excessive potential of such static waves, and apparatus should be protected by lightning arresters with a sufficiently free discharge path. If, however, the momentary grounding of the line due to the discharge of the arrester is very sudden, a certain strain will be produced between the turns of the winding near the terminal. When lightning strikes a line directly, however, which catastrophe fortunately rarely occurs, if the location of the stroke be distant from any apparatus, the lightning will soon leave the line again and reach the earth, probably over a pole. The only disturbance then actually reaching the apparatus will be a severe static wave, similar to the secondary waves of lightning described. If the line be struck close by, however, the apparatus is pretty certain to be injured.

The commonest causes of dangerous static waves, aside from lightning, are grounding of circuits, short-circuits, charging a dead line from a live transformer, parallel lines out of phase, disconnecting an insulated transmission line or cable from a live circuit, etc.

In the discussion of this paper Mr. Gossler spoke very highly, from his experience, of the utility and efficiency of barb wire as a lightning arrester.

On Thursday afternoon, by courtesy of the Quebec Railway, Light and Power Company, special cars conveyed the members and their friends to Montmorency Falls, the Shrine of St. Anne de Beaupre and the power-house of the company at Montmorency.

In the evening the annual banquet was held, which was a brilliant success.

On Friday morning a paper was read by Mr. A. A. Dion, of Ottawa, on "The Use of Storage Batteries in Electric Distribution Systems."

The writer of the paper said that the valuable properties of storage batteries, when in the early stages of their development, had made a lasting impression on his mind. Nothing, he said, had, perhaps, contributed so much to their bad reputation as the failures which followed their adaptation to city traction systems in the storage battery car. This service had been found too severe for the batteries as they were then made, just as the first electric motors employed in street railway work were found to be inadequate for good and reliable service. After many types had been brought out the range of application had been narrowed, and the battery not allowed to be sold for purposes to which it was not adapted, and the electrical engineer could not now afford to ignore the storage battery as a factor in the design of electrical plants for railway, light or power supply.

Storage batteries, he said, might be used in connection with direct-current generation and distribution for light and power service, for railway service, alternating-current generation and transmission and direct-current distribution for railway service; alternating-current generation and transmission and direct-current distribution for light and power service; alternating-current generation and distribution for light and power service.

Mr. Dion's paper was illustrated with diagrams showing various curves showing results of operation. This paper was ably discussed by Mr. Edward L. Reynolds, of the Electric Storage Battery Company, of Philadelphia, Pa., who, in connection with his remarks, stated incidentally that the storage battery had been found to be a first-class protection against static disturbances.

Mr. Ed A. Evans, of Quebec, read a paper, entitled "Electric Suburban Railways," which was quite interesting, and the subject as treated by Mr. Evans was to some extent applicable also to the steam railway engineer as well as to the electrical engineer.

The election of officers and committeemen resulted as follows:

President, B. F. Reesor, Lindsay.

First vice-president, Edward Slade, Quebec.

Second vice-president, K. B. Thornton, Montreal.

Secretary-treasurer (reelected), C. H. Mortimer, Toronto.

Executive committee (five members reelected)—Messrs. J. J. Wright, Toronto; A. A. Dion, Ottawa; John Yule, Guelph; O. Higman, Ottawa, and A. Sangster, Sherbrooke, Quebec. (Five new members elected.) Messrs. P. G. Gossler, Montreal; E. A. Evans, Quebec; A. B. Smith, Toronto; A. A. Wright, Renfrew, and G. Henderson, Hamilton.

Committee to Confer with Underwriters—Messrs. P. G. Gossler, Edward Slade, A. D. Dion, Alderman Sadler (Montreal), A. Sangster and J. J. Wright.

Statistics—Messrs. A. A. Wright, K. B. Thornton, D. R. Street.

Arc Light Rating—Messrs. O. Higman, P. G. Gossler, K. G. Thornton, John Yule, J. Roberston and A. B. Lambe.

Legislation for Ontario—Messrs. J. Yule, B. F. Reesor, A. A. Wright Hunt, A. A. Dion, Briethaupt, McCullough and J. J. Wright, with power to add to their numbers.

Legislation for Quebec—Messrs. P. G. Gossler, E. A. Evans, G. U. G. Holman, A. Sangster, with power to add to their numbers.

Standardization of Accounts—Messrs. D. R. Street, G. U. G. Holman and A. A. Wright.

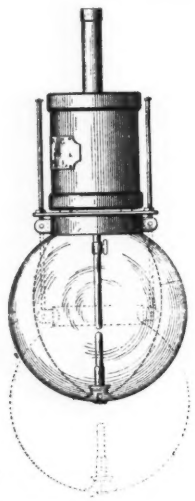
The city of Toronto was selected as the place for holding the convention in 1903.

The convention then adjourned, and at the invitation of Mr. Fred Nichols, second vice-president and general manager of the Canadian General Electric Company, Limited, the members of the association made a trip by steamer round the Island of Orleans, visiting the docks, harbor and site of the new Quebec bridge.

This convention was, without doubt, the most important both from the standpoint of the increased attendance and from that of the very high excellence of the papers read. G. A.

Electrical Patents

In order to permit the radiation in all directions of the rays of light from an arc lamp, Mr. Albert Lees, of New Bedford, Mass., has devised a novel arrangement which is constructed substantially, as follows: The inner globe of the lamp is of the usual shape and has at its upper end a metallic collar and at its lower end a metallic base. The collar is electrically connected with that portion of the mech-

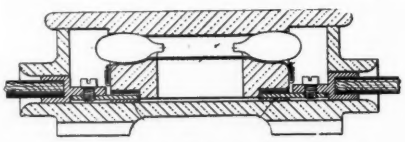


Improved Arc Lamp.

anism which serves to convey the electricity to the lower carbon, while the metallic base supports the carbon. The collar and base are connected by a network of intersecting wires which completely encloses the globe and thus forms a guard for the same. The wires are so much smaller than the arc that practically no shadow is cast by them, and even should the globe become broken, the lower carbon will still be supported by the wires.

A carbon brush formed of alternate layers of different material has been devised by Mr. William Mills, of Jersey City, N. J., who has sold his entire interest to the Eastern Carbon Works, also of Jersey City. This brush has a portion of high conductivity and another portion of relatively low conductivity, the effect being that the breaking of the circuit or the forming of the difference in potential at the brush and its cooperating surface—as a commutator, for example—occurs at a high point of resistance, resulting in less breaking and in a corresponding reduction of heat in the brush, the commutator and the brush-holder. This brush allows the active or usual current to pass through the high conductor portion, while the resistance portion takes care of the Foucault or eddy currents. In making the brush, the inventor takes stone, mica, sand, clay or other non-conducting material of a similar nature and grinds it to fine powder. Then he mixes it with a certain percentage of graphite and carbon and adds enough binder, such as pitch or molasses, to hold the parts together. The amount of resistance of the composition is governed by the proportions of non-conducting material employed. Having made the resistance mixture, he places layers of it alternately with layers of relatively high-conducting material, such as carbon, in a suitable mould, each layer being leveled with a gauge to ensure its proper thickness. Afterward the whole is subjected to high pressure, causing the layers to firmly adhere.

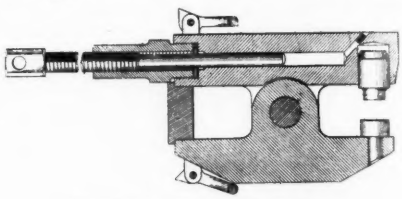
An Englishman, named Gerald William Partridge, a resident of London, has patented in this country novel means for extinguishing arcs in electrical apparatus. His aim is to provide simple mechanism which will blow out the dangerous arcs ordinarily formed on the melting of a fuse in an electrical circuit of high potential. His idea is to extinguish the arc by a jet or blast of fluid that is suddenly liberated from a containing-vessel by the action of the heat of the arc. For this purpose a vessel charged with fluid under pressure—for example, carbon dioxide—or an explosive substance that can be fired by heat—for example, gunpowder—is arranged in such a position in relation to the conductors between which an electric arc is liable to form that the fluid will be



Apparatus for Extinguishing Arcs.

liberated or the explosive charge exploded by the heat of an arc of undue dimensions set up between such conductors. The vessel may for this purpose be arranged in proximity to the space across which an arc is liable to be formed, or the vessel may be arranged to form part of the electric circuit and one of the two conductors or terminals between which an arc is liable to form. As will be obvious, a vessel containing an extinguishing charge can be constructed and applied in various ways. When the vessel is charged with fluid under pressure, it may be constructed with a nozzle or opening that is normally closed by a plug of fusible material and arranged to be heated by the arc, so that when the plug is melted the contained fluid will issue as a jet. When the vessel is charged with an explosive substance, it may be provided with fuse material arranged to be ignited by the arc and to fire the explosive. In some cases the heat of the arc may be caused to liberate a device whereby the explosive contents of the vessel will be fired by percussion.

Mr. Carl Wigtel, of Brooklyn, N. Y., has just patented a novel hydraulic riveting or punching tool, primarily intended for use in compressing and upsetting the bond rivets inserted in the rails of electric railways, though capable of employment for various other purposes. The main body of the tool is substantially cylindrical in form, having in its lower end a circular chamber that opens at one side of the same. In this chamber is arranged a ram having a riveting-post on its exposed end. The body also contains a fluid reservoir, and a small passageway leads from this reservoir to the ram chamber. At the top of the body is a hollow sleeve that is internally screw-threaded to receive a threaded shank provided on its lower end with a plunger extension that operates in the fluid reservoir. The upper end of the shank has a head



Hydraulic Riveting Tool.

to which a suitable operating tool is applied. The body is provided on the side from which the ram projects, with a pair of ears, to which is pivotally attached a jaw, having on its lower end an anvil arranged directly opposite the ram. A block is arranged to be fitted between the upper end of the body and the jaw to prevent the swinging of the latter. In use, the tool is passed over the head of the rail between the guard beams, after which the jaw is swung to proper position and held by means of the block. The ram is then actuated by turning the screw and forcing the fluid from the reservoir into the ram chamber. It will be obvious that a punch and die may be substituted for the riveting-post and anvil, or the tool might be rendered convertible by providing them with interchangeable punching and riveting devices. The tool is made of steel and weighs about ninety pounds, yet the inventor claims that he can obtain a pressure of twenty-five tons with it.

Liquefied air, when used for motive power purposes, produces about five per cent of the force spent in producing it.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Vacuum Tube Apparatus.

An interesting apparatus for vacuum tube work has been designed by Mr. Czudnochowsky. This consists of a universal apparatus made up of changeable parts, and may be made to answer most purposes of instruction and research. The main body is a vacuum bulb with four tubes attached, the whole forming a cross. One of the tubes contains an anode, and the opposite is the tube connected to the mercury pump. The two remaining tubes have wide mouths, and are intended for the reception of various cathodes and anti-cathodes. The anti-cathodes is either a flat table on which various substances can be mounted for exposure to cathode rays, or a slanting platinum plate for producing Rœntgen rays. The exhaustion of the tube requires some twenty minutes with a good mercury pump.—*Annalen der Physik* (Berlin), May 15.

Magnetic Shielding.

An interesting paper has appeared in the proceedings of the Royal Society of Edinburgh, dealing with the subject of magnetic shielding in hollow iron cylinders, by Mr. James Russell. This considers the condition which exists in shielding with a hollow iron cylinder when placed in a uniform transverse magnetic field. This transverse field, divided by the internal magnetic field, is defined as the shielding ratio. For the thin iron cylinders experimented with, it appears from various mathematical contributions to the subject that the shielding ratio, minus unity, may for the present be taken to be proportional to certain geometrical data and to the permeability, this being very high. Two iron shields were experimented with the hysteretic conditions, and when no other magnetizing force is acting upon the iron than that due to the transverse field increase by increments from zero, the shielding ratio, minus unity, is proportional to what might be called the ratio permeability, and not to the differential permeability. If, however, the transverse field is decreased by steps from a maximum, the theoretical conditions are not fulfilled, and the shield ratio increases very rapidly, but does not change sign if account be taken of the negative residual field within the shield, when at each step the transverse field is withdrawn.—*Electrical Engineer* (London), May 30.

Coast Fog Signals.

When lighthouse lights and other sea marks are obscured by fog, sound is the only medium by which warning signals can be conveyed to mariners. It has been thought that it might be possible to transmit such signals by means of etheric vibrations; but, assuming such intercommunication established, it would fail in two most essential requirements for assisting the mariner in foggy weather, as it would not give him any information as to the direction from which the warning message came, nor would it tell him how far distant the signal station was. The instrument which has proved most effective for the purpose of uttering warning sounds at points of danger is a siren sounded by means of air forced through it at a pressure of about forty pounds on the square inch. It is used in the form of a double cylinder, one cylinder fixed, the other (inside) rotated, each cylinder having longitudinal slits, corresponding in number and area, through which, as often as they coincide, the air passes. However powerful the sound-producing instruments may be, the conditions of the atmosphere have very much to do with their effectiveness. An opposing wind shortens the penetration of the most powerful sound. The sound of a siren heard on one day for a distance of twenty miles, on another day, with opposing wind and a noisy sea, will not be heard beyond a distance of one and one-quarter miles. An important conclusion appears to have been arrived at in regard to the most suitable note pitch for the blast of sirens of reed horns. In fog, the most effective note is found to be a low-pitched one. On the other hand, when the sea is disturbed, the higher pitched notes seem to be less disturbed by opposing influences, although the advantage is not very great. —*Nature* (London), May 29.

The Ions of Electrolysis.

At a lecture given before the Royal Institution of Great Britain recently, there were some interesting points brought out on the mechanism of electrolysis. Some of the experiments described were very interesting, and supplemented a most comprehensive generalization of the subject at large. In order to compare the conductivity of one electrolyte with that of another, it is necessary that we choose comparable quantities of the two, and there is no difficulty in seeing that such comparable quantities are those decomposed by the same current of electricity—that is to say, the electrochemical equivalents of the electrolytes. The molecular number of solution is the quantity in grammes of the solute contained in a litre of the solution, divided by the equivalent of the solute. Kohlrausch showed that molecular conductivity increases as the solution becomes more dilute, and with extreme dilution approaches a constant value. In order to illustrate this, an experimental apparatus consisting of an electrolytic cell in the form of a tall rectangular trough, the back and front being broad plates of glass, while the sides were composed of narrow strips of wood, completely lined with silver foil, was used. The bottom of the cell was made of non-conducting material. The two sheets of silver served as electrodes, being connected to binding screws by means of external wires. The cell is introduced into a battery circuit along with a galvanometer of low resistance. If the cell be filled with pure water there is scarcely any appreciable current transmitted. On removing the water and pouring in twenty cubic centigrammes of the 4-normal silver nitrate solution so as to cover the bottom to a depth of a few millimetres, a current passes, as indicated by the galvanometer. In these experiments the distance between the electrodes is constant, and the area of the electrodes and of the cross-section of the conducting solution is proportional to the volume of the solution, and the quantity of the salt is constant; therefore any change in the strength of the current means a corresponding change in the molecular conductivity of the dissolved salt. The molecular conductivity, therefore, increases with the dilution and asymptotically approaches a maximum.—*Science* (New York), June 6.

American Institute of Electrical Engineers.

Opening Proceedings of the Nineteenth Annual Convention at Great Barrington, Mass.

THE NINETEENTH ANNUAL CONVENTION of the American Institute of Electrical Engineers, the leading technical organization of the electrical field, is being held at Great Barrington, Mass., this week, the sessions concluding on Saturday, June 21. The attendance was large and the programme of papers and discussion of unusual excellence and ability.

The report which follows covers the proceedings until the last forms of the ELECTRICAL REVIEW were sent to press for this week's issue. An additional report, with papers read, will appear next week.

The present officers and board of directors of the American Institute are the following named gentlemen:

President, Charles P. Steinmetz, Schenectady.

Junior past-presidents, Dr. A. E. Kennelly, Philadelphia; Carl Hering, Philadelphia.

Vice-presidents, Arthur V. Abbott, New York; Gano S. Dunn, Ampere, N. J.; W. L. R. Emmet, Schenectady; Dr. Michael I. Pupin, New York; Dr. Samuel Sheldon, Brooklyn; George F. Sever, New York.

Managers, C. O. Mailloux, New York; William D. Weaver, New York; Charles S. Bradley, New York; Townsend Wolcott, New York; John J. Carty, New York; W. S. Barstow, New York; Ralph D. Mershon, New York; Calvin W. Rice, Pittsburg; John W. Lieb, Jr., New York; Charles F. Scott, Pittsburg; Professor W. Goldsborough, La Fayette, Ind.; Colonel Samuel W. Reber, Washington, D. C.

Treasurer, George A. Hamilton, New York.

Secretary, Ralph W. Pope, New York.

The officers who have been elected and who will assume office on September 4, 1902, are the following named gentlemen:

President, Charles F. Scott.

Vice-presidents, C. O. Mailloux, Schuyler S. Wheeler, Samuel Sheldon, Bion J. Arnold, Michael I. Pupin and George F. Sever.

Managers, Townsend Wolcott, Ralph D. Mershon, John J. Carty, E. H. Mullin, John W. Lieb, Jr., Charles A. Terry, Gano S. Dunn, Calvin W. Rice, W. S. Barstow, Samuel Reber and W. E. Goldsborough.

Treasurer, George A. Hamilton.

Secretary, Ralph W. Pope.

The following are the committees in charge of this annual gathering:

Committee on Papers—Calvin W. Rice, chairman, Pittsburg, Pa.; C. O. Mailloux, New York; T. Commerford Martin, New York; Dr. Samuel Sheldon, Polytechnic Institute of Brooklyn; Charles A. Terry, New York.

Committee on Transportation and Accommodation—E. H. Mullin, chairman; R. T. E. Lozier, F. A. C. Perrine, Charles W. Price, William Stanley, Herbert Laws Webb.

Local Executive Committee—William Stanley, chairman; John H. C. Church, treasurer; Harry Douglas, secretary; Parley A. Russell, Frank H. Wright, Frederick N. Deland, Charles N. Gilbert, John B. Beebe, William H. Browne, Great Barrington; F. A. C. Perrine, W. W. Gamwell, John F. Kelly, C. C. Chesney, Daniel England, Mayor, Pittsfield, Mass.; Stephen D. Field, Stockbridge; W. C. Dalzell, South Egremont.

Committee of Thursday Morning Club—Mrs. O. W. Lane, Mrs. William Stanley, Mrs. H. C. Joyner, Mrs. Alice Whiting, Mrs. A. C. Collins.

The Committee on Transportation arranged for a special train from New York city which left here promptly at two o'clock Tuesday afternoon, June 17, over the New York, New Haven & Hartford Railroad. Arrangements for this train were made with Mr. George L. Conner, passenger traffic manager of the road, who extended every courtesy in his power to the Institute in completing satisfactory train service. Much credit should be awarded to Mr. E. H. Mullin for the successful organization of this special train, and for the arrangements for hotel accommodations at Great Barrington—a task involving no end of hard work and detail.

Great Barrington, Mass., June 18—This charming little city in the beautiful Berkshire Hills of Massachusetts has outdone itself in extending a cordial greeting to the members of the American Institute of Electrical Engineers and their ladies and visitors. It is safe to predict at this hour, although the programme has only begun, that a more successful combining of severe, earnest electrical discussion and thought, with delightful entertainment, has not fallen to the lot of the Institute. To begin with a most artistic programme *de luxe,* embossed and printed in colors, with elaborate details, was handed each visitor on his or her arrival, and, as it contained blanks for autographs, will undoubtedly be preserved as a valuable remembrance of this most delightful occasion. The special train arrived here on time, and its passenger list, with attendants from other cities, filled to overflowing the Berkshire Inn, where the convention is being held, and also the hotels Barrington and the Miller. In accordance with the programme, there will be one morning session each day, beginning at nine o'clock and continuing until one o'clock P. M.

Among the members and guests who are in attendance at the present writing are the following:

T. E. Murray, New York
Mrs. Murray, "
E. H. Rice, Boston
Mrs. Rice, "
Miss Tolman, "
R. T. E. Lozier, New York
A. B. See, "
Mrs. A. B. See, "
N. F. Brady, "
Arthur Williams, "
L. Stieringer, "
Miss Ernst, "
H. H. Barnes, Pittsfield
Carl Hering, Philadelphia
A. A. Gray, New York
W. L. R. Emmet, Schenectady
W. L. Mulligan, Springfield
H. W. Buck, Niagara Falls
Mrs. Buck, "
C. P. Steinmetz, Schenectady
Gano S. Dunn, Ampere, N. J.
John W. Lieb, Jr., New York
Mrs. Lieb, "
Cary T. Hutchinson, "
A. B. Lisle, Providence, R. I.
Mrs. Lisle, "
C. F. Hopewell, Cambridge
H. R. Wellman, New York
A. H. Armstrong, Schenect'y
Mrs. Armstrong, "
T. C. Martin, New York
Mrs. Martin, "
Miss Levy, "
W. C. Andrews, "
H. C. Parker, "
J. S. Peck, Pittsburg, Pa.
Mrs. Peck, "
P. H. Thomas, "
Mrs. Thomas, "
C. E. Skinner, "
R. W. Pope, New York
R. B. Owens, Montreal, Que.
W. E. Johnson, Niagara Falls
Mrs. Johnson, "
Norman Ross, Boston, Mass.
E. J. Willis, Richmond, Va.
Mrs. Willis, "
F. A. Pattison, New York
O. S. Lyford, "
W. N. Smith, "
Charles W. Price, "
Mrs. Price, "
Miss Gray Price, "
Miss L. E. Price, "
G. F. Sever, "
W. H. Wiley, "
A. E. Kennelly, Philadelphia
A. L. Pierce, Wallingford
Harry Alexander, New York
Samuel Sheldon, Brooklyn
W. B. Potter, Schenectady
Mrs. Potter, "
W. J. Jenks, New York
C. P. Matthews, La Fayette
Wm. Mayer, Jersey City
Mrs. Mayer, "
J. E. Woodbridge, Schenect'y
Mrs. Woodbridge, "
F. B. Smith, Boston
A. A. Truesdell, Pittsfield
E. J. Berg, Schenectady
O. Smith, Bridgeton, N. J.
A. P. Jenks, Schenectady
G. A. Hamilton, Elizabeth
Mrs. Hamilton, "
Miss Hamilton, "
Miss Edith Hamilton, "
Frank G. Bolles, Cincinnati
Jos. Sachs, Hartford, Ct.
J. M. Hill, Orange, N. J.
Mrs. Hill, "
J. M. Wakeman, New York
Mrs. Wakeman, "
Joseph Wetzler, "
Mrs. Wetzler, "
Miss Ella Michaelis, "
L. B. Marks, "
C. W. Holtzer, Boston, Mass.
E. L. Nichols, Ithaca, N. Y.
H. A. Foster, Philadelphia
Joseph Bijut, New York
W. G. Lawrence, Hudson
John Murphy, Ottawa, Can.
C. K. Stearns, Boston, Mass.
J. Wilkinson, Birmingham
H. E. Heath, Windsor, Ct.
E. W. Hammer, Newark
Mrs. Hammer, "
C. A. Adams, Cambridge
A. C. Bell, New York
Wm. Cooper, Cincinnati, O.
H. Ward Leonard, Bronxville
Mrs. Leonard, "
R. W. Lohmann, New York
G. W. Patterson, Jr., Ann Arbor, Mich.
Morgan Brooks, Urbana, Ill.
H. T. Eddy, Schenectady
Mr. Eddy, Jr., "
E. G. Bernard, Troy, N. Y.
Calvin W. Rice, Pittsburg
E. H. Mullin, New York
Mrs. Mullin, "
C. O. Mailloux, "
Mrs. Mailloux, "
C. A. Lieb, "
R. D. Lillibridge, "
W. R. C. Corson, Hartford
C. C. Chesney, Pittsfield
Van R. Lansingh, Chicago
L. Knowles Perot, Phila.
Francis E Jackson, Orange
Wm. E. Haskins, Worcester
Edward Durant, New York
Allan V. Garratt, Boston
Miss Amy S. Pope, New York
P. R. Moses, "
Louis Duncan, Boston
B. J. Arnold, Chicago
R. B. Raymond, Schenectady
Wm. Esty, Bethlehem, Pa.
F. A. C. Perrine, Pittsfield
S. D. Field, Stockbridge
Wm. Stanley, Gt. Barrington
W. H. Browne, "
E. Thomson, Lynn, Mass.
W. E. Goldsborough, St. Louis
Paul Spencer, Philadelphia
F. K. Vreeland, E. Orange
Frank J. Sprague, New York
Mrs. Sprague, "
Thos. Dempster, Schenect'y
L. Gutmann, Peoria, Ill.

The programme of the opening day was begun promptly, and there is every indication that this convention will be without its equal in the meetings of this constantly growing technical organization. Last

night a reception was held at the Berkshire Inn, and an address of welcome delivered by Mr. William Stanley, chairman of the local executive committee.

In a graceful speech Mr. Stanley endeared himself to every one present. He said, in part: "Members of the Institute, ladies and gentlemen—A very pleasant though unfamiliar duty has fallen to my lot this evening, for I am instructed by the good people of Great Barrington, by their neighbors in the adjacent villages, by the Mayor and the citizens of Pittsfield, in fact, by all the inhabitants of the hills and valleys of Berkshire, to extend to you a most hearty welcome. A year ago, when we sent you an invitation to hold your meeting among us, we were well aware that we could not hope to offer to you the attractions that are most intimately associated with your profession, attractions which you have been accustomed to find when assembled in the larger cities of the country, for we have few engineering enterprises, and the arts and sciences are not widely practised among us. I may as well confess it—we are a simple pastoral people dwelling among these hills. To us no pastures or meadows are so green, no mountain brooks so joyous, no pine so fragrant, no elms so stately as those of Berkshire. Upon this very spot, some seventy years ago, there dwelt one of the sweetest singers of the era, who, in "Thanatopsis," "The Water Fowl," "Green River," and other poems, expressed the inspiration he gathered among these hills. A little way up the valley Hawthorne lived beside a lake and wrote those wonderful stories that have made his name immortal. From Stockbridge, near at hand, came Field, the man who dared to lay the first cable beneath an ocean. Just down the street, in an ancient house, Franklin Leonard Pope, second president of this Institute, passed his boyhood days and met his most untimely death; and so I might almost indefinitely extend the list of those who, carrying from these hills and valleys most noble thoughts have done much for their country. While we rely to some extent upon the natural beauties of our country to make your visit pleasant and agreeable, we would hardly have dared to undertake the responsibility of entertaining you on this occasion had nature been our only attraction. We shall hope to persuade you that not even June arrayed in her loveliest robes is as fair as are the ladies who are to assist us during your visit. Our little village can point with pride to the Thursday Morning Club. We have entrusted to them the conduct of such functions as we shall be able to offer to you, a decision which I am sure you will heartily endorse. I know that I am expressing the sentiment of your hosts this evening if I have made plain to you in this brief message that our most cordial greeting is not only extended to the American Institute of Electrical Engineers, but that it also has a personal significance to each and every one of its members."

The response to Mr. Stanley's address was made by Mr. T. C. Martin. Mr. Martin eloquently thanked the committee for the splendid auspices under which the Institute had been received, and, following up Mr. Stanley's remarks, paid a feeling tribute to the memory of the late Franklin Leonard Pope.

Dancing was begun immediately after the addresses, and supper was served at 11 P. M., after which there was a general breaking up of the parties, the guests who had come from the Barrington and Miller and other adjacent points being returned to their respective headquarters in special conveyances. There has probably never been a convention at which so many ladies have been present. That everybody had immensely enjoyed the reception, and that Great Barrington had carried out this part of its programme in an eminently successful fashion, was evidenced by the hearty expression of satisfaction heard on every side.

President Steinmetz called the first meeting of the convention to order in the auditorium of the Berkshire Inn, which was tastefully decorated, and being surrounded by every evidence of natural generosity, a most refreshing and intellectual period was indulged in. President Steinmetz spoke briefly to the effect that never before had a convention of this nature been opened under such pleasing conditions. He paid a gracious tribute to the people of Great Barrington and the adjacent cities for the unrestricted kindness with which they had endowed every effort, and prophesied that it would be long before the pleasant memories impressed by this occasion should be erased from the minds of every individual who had any part in them.

The first paper called for was by Mr. F. G. Baum, of Stanford University, California, on "Method of Compounding Alternating-Current Generators and Motors, Direct-Current Generators, Synchronous Motor-Generators and Synchronous Converters." Mr. Baum unfortunately was unable to be present, and his paper was comprehensively abstracted by Dr. F. A. C. Perrine. Dr. Perrine elaborated upon the essential points of this paper, and made notes from time to time in explanation of several points which he wished carefully to set forth.

President Steinmetz then suggested that, following the usual custom, all of the papers for that day's programme should be read in order, when the discussion would be taken up. He then called for a paper on "The Formula for Calculating the Electro-Motive Force at Any Point of a Transmission Line for Alternating Current." This paper was written by M. Maurice Leblanc, of Paris, France. Mr. Steinmetz stated that it was the great pleasure of the Institute a few months ago to have the presence of M. Leblanc at one of its meetings, and that since that time he had not only become a member of the Institute, but was taking a deep personal interest in the scientific progress of its members. M. Leblanc could not be present, and his paper was abstracted by Mr. Percy H. Thomas, of Pittsburg. Mr. Thomas, in explanation of his paper, said that there was no appreciable difference in time in the charging up of the far and near ends of an ordinary circuit. In special cases, however, and in the future, when long-distance lines would be very common, and especially in underground lines, there would be an appreciable difference. The condition which causes this is the fact that the inductance and capacity of the cable are distributed. M. Leblanc arrives at a rigid statement for determining the voltage at any point of such a line under the conditions which he assumes.

The next paper called for was on "The New Generating Plant of the Niagara Falls Power Company," by Mr. Harold W. Buck, of Niagara Falls, N. Y. Mr. Steinmetz spoke of the progress that had been made in this great power plant, and said that it was always a pleasure to hear a report from the engineers of the Niagara Falls Power Company. It was the custom, he said, to have such a paper read in full, and requested that Mr. Buck do so on this occasion. Mr. Buck then read his paper in full, and the conclusion of his reading was followed by the hearty applause of every one present.

The next paper on the programme was "Notes on an Experiment with Single-Phase Alternators on Polyphase Circuits," by Mr. C. O. Mailloux, of New York. Mr. Mailloux was not present at the session, and it was moved that the reading of this paper be postponed until he could have an opportunity to do so.

President Steinmetz then read by title his paper on "Notes on the Theory of Synchronous Motors, with Special Reference to Surging." It was not his intention, he said, to read his paper, or even to abstract it. The conditions were such, he thought, that the engineer must find time to read such a paper and digest it quietly. He elaborated, however, on the conditions under which this phenomena occur, and in his customary forceful manner presented in a highly satisfactory manner a very clear version of his ideas upon this subject.

Professor L. A. Herdt, of Montreal, not being present, the reading of his paper, "The Predetermination of Alternator Characteristics," was postponed until the next session.

After the reading of the papers, President Steinmetz gave the floor to Secretary Pope, who read two letters of regret, one from Governor W. Murray Crane, of Dalton, Mass., and the other from the Hon. George B. Lawrence, member of Congress, of North Adams, Mass., expressing their regret at their inability to be present on this occasion. President Steinmetz then asked Dr. Perrine to lead in the discussion. Dr. Perrine said that he had a letter from Mr. Baum, which was written for the purpose of answering enquiries which it was thought would arise. He suggested that he would read the letter and provoke enquiries. This letter contained some further facts which were not brought out in Mr. Baum's paper, and Mr. P. H. Thomas then made a few brief enquiries with relation to getting rid of the sparking in a fifteen-kilowatt machine as against a 200-kilowatt machine. M. Leblanc's paper was then very ably discussed, and then Professor Horace T. Eddy suggested that in reality the finding of the voltage at any point was more simple than the complex mathematics of the subject would seem to indicate, and that the solution might be made more easy by using the analogy of the hydrodynamic principle. This, he thought, showed more clearly to the mind just what was going on in the electric circuit, and it seemed to him that this principle could be utilized to serve as a means of understanding this phenomena.

Dr. Perrine then took up the discussion upon Mr. Buck's paper. He spoke of the difficulty of carrying the heavy shaft, and whether any change had been made in the thrust bearing. It seemed to him, he said, when visiting the plant with some western engineers, that the heavy shaft was running out of line. This, he thought, would bring about what was commonly known as crystallization, but was not crystallization, but the overcoming of the elastic limit. He asked if anything had been done to prevent what appeared to him to be wobbling. The question of the efficiency of the machine was also brought up. Mr. Buck, in reading his paper, had made the statement that the system of using a bench-board in combination with the switchboard had been carefully considered, and had been rejected as impracticable. Dr. Perrine agreed with Mr. Buck on this question, and, continuing, said that it was only in power stations which were so small that the switchboard would be adjacent to the bench-board that this system would be of any practical benefit. He also thought that all recording apparatus should be in the superintendent's office, and that, in his mind, there was no more reason for these instruments to be on a switchboard than a lightning arrester. The switchboard attendant should not be burdened with the watching of any instrument but that which he was directly responsible for, and the superintendent should have under his eye every instrument, the needles of which showed him at any time just exactly what he might expect. He thought also that the change from the external revolving field to the internal revolving field was a good one mechanically.

In reply to Dr. Perrine's remarks, Mr. Buck said that the thrust bearing had been taken care of by a special device of intricate design in the new plant, and that he thought the eccentricity which Dr. Perrine had noticed was an apparent one only, due to the shaft being hollow and made of lapped construction. The efficiency of the main machines had not actually been found, but the guaranteed efficiency was somewhat over ninety-seven per cent. He then explained that the type of the generating apparatus for the new plant was not in use in any other part of the United States, but had been used with great success in Switzerland and Germany. He explained the regulating principles employed, and upon the question by Mr. P. H. Thomas as to whether his company would have to pay duty on the power sent into Canada, he said that the United States Congress and the Dominion Congress had come to a reciprocal agreement upon this point. He said that Congress argued that electricity was an imponderable substance and could not be weighed, and was therefore not dutiable.

Replying to an enquiry as to the progress which had been made for the transmission of power to Toronto, and the comparison of that climate for this distance with that of Southern California, which had been found so favorable for long-distance transmission, he said that negotiations were now pending, and that he thought the lines would be well under way by the summer months. This would, in all probability, be operated at from 40,000 to 60,000 volts. He explained the construction of the transformers, which were wound, he said, with five similar coils, the same number of coils and insulation, each equipped for 5,000 impressed voltage. He then explained how the ratios would be affected by the different connections by the coils and transformers. The company, he said, was experimenting with high-tension insulators of a novel design, which were essentially five continuous petticoats on a hollow insulator. These were supported upon metal trunnions, running a short way into the hollow insulator. These were being made of porcelain and glass, ranging from eight to fourteen inches in diameter. The construction of these insulators, he thought, was such that it was not probable that the cable would be punctured at any time, and that they would be as serviceable in wet weather as in dry, as the drip was provided for at each point on the five turns of the petticoats.

Mr. C. A. Adams, in speaking with reference to the paper by President Steinmetz, made a graphical explanation of the theory which he had used and found of great success in his class work. This system, he said, he had never seen published to any extent, and his remarks on this subject were received with great satisfaction by those present. President Steinmetz then gave the floor to Mr. Stanley, who explained several features of the programme.

A great many of the members present visited the works of the Stanley Instrument Company during the afternoon, and later a lawn tea was served at the beautiful residence of Mr. Stanley, at "Brookside," under the auspices of the Thursday Morning Club.

The lawn party at Brookside was a great success. Mr. Stanley and members of the local committee and the Thursday Morning Club, under whose auspices this was held, received the guests.

The lantern-slide entertainment at the town hall on Wednesday evening was largely attended, Messrs. Elihu Thompson, Martin, Jenks and others speaking and describing some very interesting pictures.

THURSDAY'S PROCEEDINGS.

[*Special telegram to the* ELECTRICAL REVIEW.]

Great Barrington, June 19—President called the second meeting to order promptly at nine o'clock. The first paper on the programme was by A. H. Armstrong, of Schenectady, N. Y., on "A Study of the Heating of Railway Motors." Mr. Potter read a paper on the "Comparative Acceleration Tests of Steam and Electric Traction," by Messrs. B. J. Arnold, of Chicago, and W. B. Potter, of Schenectady. Mr. Mailloux being present at the time his paper, which was held over from yesterday, was read. This was discussed by Messrs. Steinmetz, Porter, Dion and others. Mr. Steinmetz described some experiments he had made in this subject some eight or ten years ago and illustrated them by graphic demonstration on the blackboard.

The extremely timely and important paper by Mr. Bion J. Arnold on the "Method of Ascertaining by Means of a Dynamometer Car the Power Required to Operate the Trains of the New York Central & Hudson River Railroad between Mott Haven Junction and Grand Central Station, and the Relative Cost of Operation by Steam and Electricity," was received with great interest and applause.

In discussing the choice of system, Mr. Arnold concludes that the alternating-current railway motor will yet prove to be the most efficient, all things considered, for long-distance railway work. It has not yet, in his opinion, demonstrated its ability to start under load as efficiently, or to accelerate a train as rapidly as the direct-current motor. Furthermore, direct-current motors, with their necessary auxiliaries, have become fairly well standardized, and it is the only class of electric railway apparatus available from the manufacturers of the United States without involving experimental work and large developing expense. In view of these facts and the probable necessity for rapid construction on the road under con-

sideration, he refrained from advising anything of an experimental nature, and therefore recommended the direct-current system in combination with the third-rail main line and overhead construction for the yards, all of which have proved their ability to meet the conditions imposed by railway operation as far as motive power is concerned. Had the length of the road under construction been considerably greater, and had it been possible to secure sufficient time to conduct experiments and invite demonstrations by manufacturers of alternating-current equipment, this class of apparatus would have been more seriously considered. A careful compilation of all the expenses entering into the operation of the present steam service was made, and a comparative total of relative costs secured, which is believed to be accurate, assuming that the present locomotives running between Mott Haven Junction and Grand Central Station should be abandoned, and the service now performed by them duplicated by electric locomotives. It is assumed that the electric locomotive will be operated by the same class of men as those who now operate the steam locomotives, and that they would receive the same rate of pay that they now receive. This condition is not favorable to electric traction, as it is not ordinarily necessary to have two men to operate an electric motor; but in Mr. Arnold's judgment, it is not advisable to operate a service of this class under such exacting conditions without two men on each locomotive. If the motor-car system should be adopted, as it probably would be were the electrical equipment extended beyond Mott Haven Junction, or if the forward guard or brakeman were allowed to take the place of the second man while passing through the tunnel and yards, a saving equivalent to his wages could thereby be effected. With two men of the same skill, as at present employed, the operating expenses per locomotive-mile, exclusive of fixed charges, but including water, labor, cost of cleaning and repairing the tunnel, and other expenses of locomotive operation, would be: For steam, 23.05 cents; for electricity, 15.80 cents. The fixed charges per locomotive-mile, assuming it now requires forty locomotives to perform the present service, and that thirty-three electric motors could perform the same service, would be 1.13 cents for steam and 7.83 for electricity, making a total of 24.18 cents for steam, and 23.63 cents for electricity. From these figures it appears that while there would be a slight annual saving in operating expenses in favor of electricity, it is not sufficient to warrant its adoption on the ground of economy in operation alone, although its adoption can be justified on other grounds. These figures could be made more favorable to electricity were an optimistic view of many of its advantages taken, and the probability is that practical operation will show a somewhat greater gain than here indicated. It is safe, however, to conclude that the saving in operating expenses by the electric system would be sufficient to offset the increased fixed charges due to the additional investment made necessary by its adoption.

After complimenting Mr. Arnold on his fine paper, Lieutenant Frank J. Sprague said he was glad that the New York Central Railroad problem had been taken up in this manner, and that it agreed with his own investigations. He pointed out that the vital question—and one of immediate importance—was that of safe operation rather than that of economy. On account of the peculiar nature of the problem, if the New York Central Railroad should wait until improvements in electrical apparatus should show a material saving in operation, steam would remain the motive power in the tunnel. The abolition of steam, smoke and what was of almost equal importance, the adoption of electrical instead of hand-operated controllers, leaving the engineer absolutely free to devote himself to the safe piloting of the train, would ensure an element of safety, even at higher speeds, that would make puerile predictions of holocausts. The problem, he thought, was twofold—first, the replacing of the great variety of existing locomotives, built for all kinds of service, by units of one or two classes of electric locomotives, to take the place of steam locomotives at some convenient point above Mott Haven, and second, the hauling of suburban service by individually equipped motor cars under the multiple unit system. The whole problem, of course, should be worked out in connection with the many civil engineering and railway problems necessarily presented by the limited yard room now existing at the Grand Central Station. Dividends should be looked for, not so much in the saving of cost of operation as in the increase of traffic. Mr. Sprague concluded by stating that he was perfectly prepared, as he had no doubt others in the room were, to undertake within six months, as a special problem, the hauling of a 700-ton train from Mott Haven to Forty-second street under conditions of safe and efficient operation at schedule, although, of course, any general equipment would require two or three years to be carried to conclusions.

A letter of regret was read from President-elect Charles F. Scott, who is at present in Berlin.

Mr. C. O. Mailloux read his paper on "Notes on Railway Speed-Time Curves," which was ably discussed.

The lecture by Dr. Arthur E. Kennelly, of Philadelphia, on "Wireless Telegraphy" before the Thursday Morning Club and their guests at Kellogg Hall was attended very largely, and the subject was received with very great interest.

An organ recital was given this afternoon at the "Barrington House" by Mr. Searles to visiting members of the Institute and their ladies. A few special invitations were also issued to others than Institute members, and a splendid programme was played by Mr. Henry Rowe Shelley.

The assembly ball at the town hall was very successful, and a large number of the members and ladies and many of the local people greatly enjoyed this event. The town hall was elaborately decorated with festoons of evergreens and colored electric lights. The emblem of the American Institute of Electrical Engineers was reproduced in illuminated colored bulbs on the front of the hall producing a splendid effect.

The programme for Friday and Saturday is as follows:

FRIDAY.

Friday, June 20, 9 o'clock—Papers and discussions upon general topics as follows:

11. "The Function of Series and Shunt Resistances in Lightning Arresters," by Mr. Percy H. Thomas, of Pittsburg, Pa.

12. "A New Photometer for Incandescent Light and Similar Sources," by Professor C. P. Matthews, of La Fayette, Ind.

13. "A New Type of Current-Tracing Instrument," by Professor R. B. Owens, of Montreal.

14. "Energy Loss in Commercial Insulating Materials When Subjected to High-Potential Stress," by Mr. C. E. Skinner, of Pittsburg.

15. "The Electrostatic Wattmeter in Commercial Measurements," by Mr. Miles Walker, of Pittsburg.

16. "Report of Committee on Standardization," by Dr. A. E. Kennelly, secretary.

Friday afternoon, by courtesy of the Stanley Electric Manufacturing Company a special train will take the party to Pittsfield, where the works of that company will be visited and a lawn tea served at the home of Dr. F. A. C. Perrine. In the evening the Institute will be entertained at the Maplewood as the guests of Mayor England and the Board of Aldermen of the city of Pittsfield.

SATURDAY.

Saturday, June 21, closing session, 9 A. M.—Papers and discussion upon the education of an electrical engineer.

17. Opening address upon the general subject, by President Steinmetz.

18. "The Present Status of Electrical Engineering Education in the United States," by Dr. Samuel Sheldon, of the Polytechnic Institute of Brooklyn, N. Y.

19. "The Equipment of an Electrical Engineering Laboratory," by Professor R. B. Owens, of McGill University, Montreal.

20. "Electrical Engineering Courses at College," by Professor William Esty, Lehigh University, Bethlehem, Pa.

21. "The Education of an Electrical Engineer," by Mr. Harold W. Buck, of Niagara Falls, N. Y.

22. "The Electrical Engineering Courses at College," by Mr. E. B. Raymond, of Schenectady, N. Y.

Manager Bruce, of the new Hotel Aspinwall, at Lenox, has extended to the Institute the courtesies of his house for dinner Saturday afternoon, with transportation to and from Lenox station to all who desire to visit this charming resort in the Berkshire Hills. Those who can spare the time will not only enjoy a beautiful trip but may desire to extend their stay over Sunday.

Concentration.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In reading over a recent number of the ELECTRICAL REVIEW, I was much interested in the editorial on "A Neglected Branch of Study." It is admirable throughout, but there is one very important point which is overlooked in our preparatory schools, and which results in making the work in colleges and technical schools, and even in after life, much more difficult. I refer to the desirability of impressing upon the boys of the higher preparatory schools the necessity of "Concentration" upon any work they may have in hand. This I have found, practically, makes a vast difference in the results obtainable.

The boys in colleges may devote ample time to their studies, but they do not get commensurate results because the necessity for concentration upon the work in hand has not been duly impressed upon them.

These habits once acquired will make the other colleges and technical schools much easier, and will make the boys more effective and efficient when they enter upon their work in life. In my opinion, too much stress can not be laid upon the acquirement of this habit in the preparatory schools.

The acquirement of this, combined with the habit of thinking concisely and expressing themselves so in writing and in speech, will go far to produce men who will secure the maximum results in their life's career.

E. L. ZALINSKI.
222 Fifth Ave., Capt. U. S. A. (Ret'd).
New York, June 10.

Electrical Contractors' Association of New York.

The second annual meeting of the Electrical Contractors' Association of New York will be held at Albany on July 15, under the auspices of the Eastern New York Electrical Contractors' Association, the headquarters being at the Hotel Ten Eyck. A directors' meeting at 9 A. M., July 15, will be followed immediately by a meeting of the delegates. At 12 o'clock noon a trolley ride will be taken to Schenectady, where the works of the General Electric Company will be inspected and a lunch served. It is proposed to return by the way of Troy and Watervliet, if the trolley road now in course of construction is completed. At 8 P. M. of the same day the delegates will leave by the steamer Adirondack for a trip to New York city, and it is proposed that a banquet be served on the boat after leaving Albany. Speeches will be made by the members of the different associations, and Mr. Charles L. Eidlitz, president of the National association, will act as toastmaster.

A Press Outing on the Erie Railroad.

Mr. D. W. Cooke, general passenger agent of the Erie Railroad, took a party of newspaper men and ladies to Buffalo and Niagara Falls last week. The outing extended over three days, and was most pleasant throughout. Mr. A. A. Schantz, general passenger agent of the Detroit & Buffalo Steamboat Company, took the party from Buffalo to Detroit and return on the fine new lake steamer, Eastern States. The trip was a source of much enjoyable sightseeing and recreation.

At Buffalo, after an early breakfast at the Ellicott Club, and a drive through the city, a special Erie train took the party to Niagara Falls, where, on specially provided parlor trolley cars, the Canadian side and the Gorge Road were visited. After a bountiful luncheon at the International Hotel, Niagara Falls, and a drive, the return was made to Buffalo over the Buffalo & Niagara Falls electric line in record-breaking time. General Superintendent Bert L. Jones, of the Gorge Road, accompanied the party. The usual time of this trip is one and one-half hours, and on this occasion it was made in an hour and sixteen minutes. The party was joined at Buffalo by Mr. H. T. Jaeger, general agent of the passenger department of the Erie Railroad at that point.

On board the steamer Eastern States Thursday and Friday nights impromptu entertainments were arranged by Mr. Cooke and Mr. Jaeger. The ladies caught the spirit of the informal and enjoyable occasion, and participated not only in the singing, but in the story-telling as well, to the enjoyment of every listener. "The Life of Murphy, or Twice-Told Tales" was presented as a one-star tragedy by Mr. J. R. Youatt, of the Associated Press. Several familiar stories were related by some daring newspaper spirits, which were welcomed by singing "Ain't It a Shame," "Should Old Acquaintance Be Forgot," etc., in which all joined.

In Detroit, the party participated in trolley and tally-ho rides, and were entertained at a midday frog and fish banquet given at the Cadillac Hotel by Mr. Schantz.

The ride from Buffalo to New York on Saturday proved to be a very enjoyable day trip. The beautiful scenery of the picturesque Erie road was never more in evidence, as the result of the recent rains. Several record-breaking miles were made, with a member of the press occasionally on the locomotive, but fortunately not holding the lever, but rather holding on to the sides of the cab and mentally wondering how in the world he ever decided to venture to ride on the dizzy engine. At the beautiful Portage Falls the entire party was photographed by Mr. Lucky, of *Leslie's Weekly*, with the engine as the background.

A brief visit at Shohola Glen, where a band extended a welcome of various kinds of music, and where girls dressed in American flags presented bouquets to the visiting ladies, completed the day's enjoyable incidents.

Before breaking up, formal resolutions were adopted, expressing in cordial terms appreciation of Mr. Cooke's courtesy in giving this outing. These were presented on the train by Mr. Powers, of the *Journal of Commerce*, to which Mr. Cooke responded in a graceful little speech. At Detroit, also, a resolution of thanks was voted Mr. Schantz.

A more enjoyable occasion, or one more agreeably and thoughtfully carried out, could not be imagined, and none of this particularly congenial party will ever forget the many interesting events of this rail and water ride under the care of Mr. D. W. Cooke, of the Erie Railroad. Mr. Frank Presbrey assisted Mr. Cooke in making the arrangements for the trip, and both gentlemen are to be congratulated over its pronounced success. The new compartment cars, hereafter to be run on the Erie Railroad between New York and Buffalo, were provided for the trip out. The inauguration of these modern cars is another evidence of the enterprising management of the Erie passenger service by Mr. Cooke.

The rest of three days from arduous work was too much for several of the gifted newspaper men of the party, and several poems and other alleged literary productions were sprung upon the party at different times. The guilty ones were not always easily discovered, but the finger of suspicion pointed very strongly to Pomeroy Burton, of the *World*, and Edward P. Call, of the *Evening Post*. Probably there were others, as Palmer, of the *Commercial Advertiser*, and Gardiner, of the *Journal*, looked too innocent at times.

The members of the party were: Mr. D. W. Cooke, G. P. A. Erie R. R.; Mr. W. L. Derr and Miss Derr, Erie R. R.; Mr. and Mrs. Edward P. Call, N. Y. *Evening Post;* Mr. Henry Loewenthal, N. Y. *Times;* Mr. and Mrs. Fred Perry Powers, N. Y. *Journal of Commerce;* Mr. and Mrs. Pomeroy Burton, N. Y. *World;* Mr. and Mrs. James Martin, N. Y. *Tribune;* Mr. and Mrs. J. R. Youatt, Associated Press; Mr. and Mrs. William Ray Gardiner, N. Y. *Journal;* Mr. and Mrs. L. B. Palmer, N. Y. *Commercial Advertiser;* Mr. and Mrs. J. G. Carpenter, Brooklyn *Eagle;* Mr. Vincent Cooke and Miss Cooke, N. Y. *Press;* Mr. and Mrs. Frank Presbrey; Mr. Fred Knowles, Brooklyn *Times;* Mr. H. L. Bridgman, Brooklyn *Standard Union;* Mr. Charles W. Price and Miss Leonice E. Price, ELECTRICAL REVIEW; Mr. and Mrs. Wm. P. Hamilton, *Marine Journal;* Mr. Frank Hoyt and Miss Hoyt, *Outlook;* Mr. and Mrs. L. B. De Veau, *Harper's Weekly;* Mr. and Mrs. Felix Lamond, *Churchman;* Mr. J. A. McKay and Mrs. McNeir, *Town and Country;* Mr. and Mrs. Louis Cassier, *Cassier's Magazine;* Mr. William Bancroft, *Outing*, and Mr. G. W. Lucky, *Leslie's Weekly.*

Telephone Apparatus—I.

New and Standard Designs from the Leading Manufacturers of Telephone and Kindred Apparatus.

Improved Telephone Apparatus.

The Holtzer-Cabot Electric Company, of Brookline, Mass., has recently added some very important improvements in

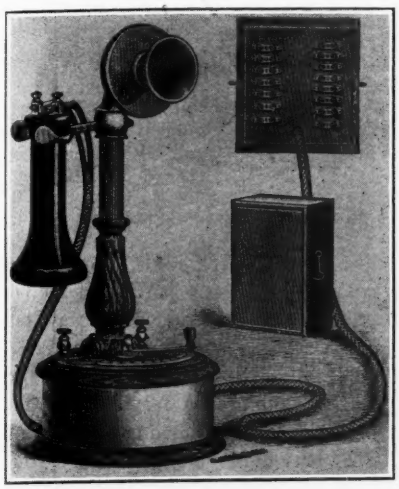


FIG. 1.—NESS AUTOMATIC DESK SET.

telephone apparatus to its long list of successful and popular manufactures. In the accompanying illustrations are shown the new Ness automatic desk set and a new double-wound machine and a new motor-generator.

The Ness automatic desk set, Fig. 1, is the company's latest style of desk instrument. It is equipped with a pedestal similar to that used in the ordinary single line telephone, and with the switch mechanism of the Ness automatic system located in the base. By combining the Ness automatic switch with a desk set of this character, the company claims to have a very convenient and ornamental instrument, and believes that it will be received with great popular favor. In operation the mechanism which affects the restoration of the switch is very ingeniously brought about, the actual method of construction being extremely simple. The lever of the selective switch is adapted to be rotated over various contact buttons, being held in any position to which it has been rotated by means of a ratchet wheel which is connected by a spring pawl. Upon the short-arm hook of the lever, which forms a normal support of the receiver, a pivoted dog engages a notch in the pawl, when the receiver is replaced upon the hook, and leaves the pawl out of engagement with the ratchet wheel, thus allowing a spiral spring to return the switch lever to its right-hand position in contact with the home button. After raising the pawl out of the ring on the ratchet wheel, the dog slips out of the notch on the pawl, thus allowing the latter to return into contact with the ratchet wheel, in order to be ready for the next use of the telephone.

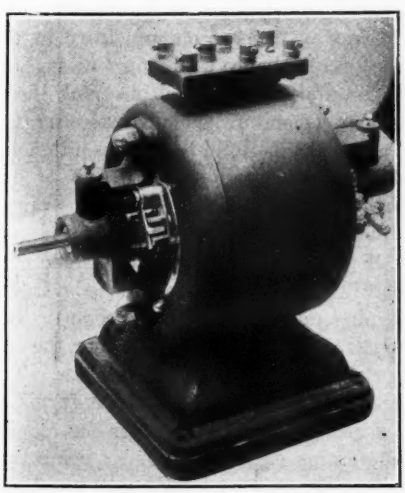


FIG. 2.—DOUBLE-WOUND MACHINE.

In order, however, that the pawl may not engage the ratchet before the lever has fully returned to its normal position, a second dog is provided which is pressed by a spring so as to occupy a position under the pin carried on the pawl, thus holding it out of engagement with the ratchet wheel until the rotation of the lever is completed. At this point a cam on the under side of the ratchet wheel pushes the dog out of engagement with the pin, and thus allows the pawl to drop into position against the ratchet wheel. No matter whether or not the user thinks to return the switch to its home position, any action on his part is compensated by the switch-arm returning of its own accord to the other position as he hangs up his receiver.

The double-wound machine shunt in Fig. 2 is of an entirely new size. It consists of a double-wound armature, the primary being run upon a direct-current circuit and the secondary delivering alternating and pulsating current for ringing purposes in connection with central energy telephone systems. The alternating current is delivered at a voltage of about eighty and a frequency of about 1,000 cycles per minute.

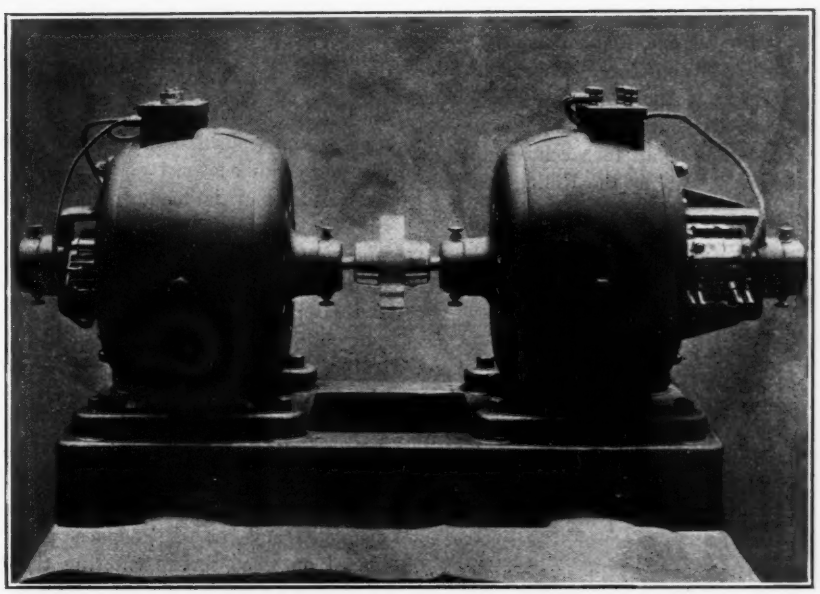


FIG. 3.—NEW SIZE MOTOR-GENERATOR.

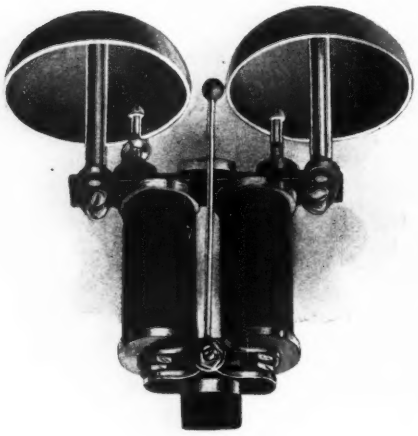
Outside of the collector rings is a third ring which is formed of two segments of unequal length. These are connected up to the secondary winding in such a way that they deliver with half the wave of each cycle. They are connected up to the binding-posts in such a way, however, that while a certain binding-post will be positive with respect to one of the pressures

bearing upon this ring, it will be negative with respect to the other. This form of mechanism is used in connection with bells of special construction which respond only to the pulsating wave, an arrangement which greatly increases the scope of the party-line system of telephone.

The motor-generator shown in Fig. 3 consists of two machines coupled on one base. Its province is quite similar to that of the double-wound machine, except that the primary and secondary are separated by insulating material, making it suitable for circuits whose voltage is higher than 220. This also is equipped with a pulsating ring, so it will deliver both alternating and pulsating current. This is an unusual size for machines of this class, having one-half horse-power frame and delivering between 250 and 300 watts.

The Smallest Multiple Spring Jack.

A piece of apparatus, shown for the first time and one that received a great deal of attention from prominent telephone men at the Interstate Telephone Convention, recently held in Chicago, was a three-tenths of an inch centre multiple spring jack, built by the Kellogg Switch-



A New Ringer.

board and Supply Company, Chicago, Ill. The jack is known as a two-conductor jack, and is built of the best grade of hard rubber, brass and German silver. There being only one spring in the jack and two contacts in the plug, the three-tenths of an inch jack can be built substantially and have as high insulation resistance as most jacks on three-eighths of an inch centres.

This type of jack will be used in the 18,000-line switchboard, which this company is building for the Frontier Telephone Company, Buffalo, N. Y., also in the 15,000-line board, being built for the Home Telephone Company, Los Angeles, Cal.

An illustration of the amount of work involved in building the multiple jacks alone for a 15,000-line board may be gained by the following brief facts:

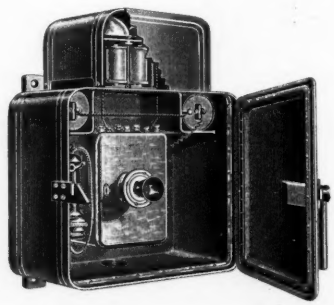
The ultimate number of spring jacks required for a board of this size is 645,000. The ultimate number of strips of multiple jacks is 32,250. The spring jacks for the ultimate equipment, placed one on the end of another, would reach thirty and one-half miles. The strips of multiple jacks, placed one on the end of another, would reach three and one-half miles. The total number of strips (32,500), even though only three-tenths of an inch thick, piled one on top of the other, would make a column 812½ feet high.

In the accompanying illustration is shown a new ringer recently placed upon the market by this company and which is a decided novelty to the telephone public. The company states that it is only after a study of this subject, extending over a long period of years, that it has been produced. This new ringer embodies the decidedly new feature of letting the armature remain in its place and causing the pole-pieces to move toward or from it when the adjustment is made. Screw extensions are placed in the end of each core, which may be readily moved toward or from the armature by an ordinary wrench, and afterward locked in place by a lock nut, both of which are shown in the illustration. It is at once the simplest form of adjustment ever produced, and is not only substantial, but affords an extremely delicate adjustment. The ringer has been made self-contained. The gong-posts are mounted on the same frame as the ringer magnets, and no dependence need be placed on wood screws entering the lids of the generator box for maintaining the adjustment of the gong.

A Mine and Railway Telephone Set.

The mine and railway telephone set which is shown in the accompanying illustration has been made by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, Ill., with the special intention of meeting the conditions of bad weather and severe usage which this service entails. The iron box which protects the telephone proper is claimed to be absolutely water-tight and weather-proof. The ringers are mounted in the upper part of the box, with an opening at each side, so that the call may be heard at some distance from the telephone. These openings are so arranged that the apparatus is protected not only from the weather, but also from mechanical injury due to a mischievous desire on the part of any one to insert sticks through the opening or to meddle otherwise.

The talking and calling apparatus is particularly arranged to suit the purposes



Mine and Railway Telephone Set.

for which the telephone is supplied, and is located in the lower portion of the box. In mines and in bridged railway telephone service a wooden box contains all of the apparatus. Ample space is provided in the outer box for the removal of the receiver and the turning of the crank.

The cover of the box fits tightly over a rubber gasket, and when the door is closed the box may be placed in exposed conditions and continue to give reliable service under the most severe operations. Four-inch gongs are employed, it having been the experience of this company that bells of this size can be heard at a sufficiently great distance for all practical purposes.

A Portable Lineman's Testing Set.

The testing set shown in the accompanying illustrations is a complete long-distance instrument manufactured by the Electric Appliance Company, Chicago, Ill. It is equipped with a powerful three-magnet generator double-pole receiver, the Eaco Bell type solid-back transmitter, induction-coil buzzer and two cells of dry battery.

The weight complete is eleven and one-half pounds, and it measures six and one-half by seven and one-half inches. In designing this instrument, the company has made a special effort to consider the important factors of weight and size. The generator is equipped so that it furnishes a direct pulsating current or the regular alternating current, the object being that when a lineman in testing may not desire to call a subscriber, a switch is manipulated on top of the box, and on the generator being turned a direct current is given which will not ring the polarized bell on the subscriber's telephone, but will throw the drop or indicator on the switchboard.

The receiver is cut in in series with the

buzzer so that it is not absolutely necessary to depend on the buzzer alone for receiving a signal. In testing, a receiver is much more sensitive than any ringing movement. This instrument is what would be commonly called a series instrument, but a special coil of high resistance wire is provided, so that in listening for a test ring on bridging or party lines all the current will not flow through the testing set. A switch is provided which, when closed, short-circuits or cuts out this resistance. The company claims to have accomplished this result in this instrument, which will answer for both

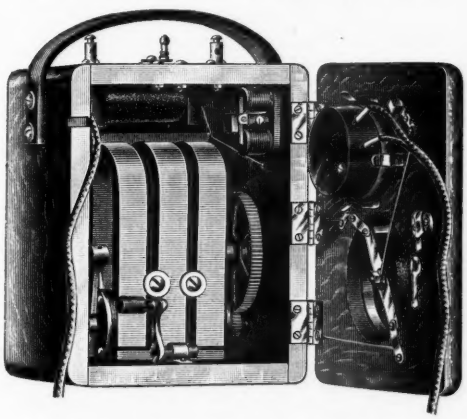


FIG. 1.—INTERIOR VIEW OF PORTABLE LINEMAN'S TESTING SET.

series or bridging work, and which is practicable, durable, compact and light in weight. Each instrument, as may be plainly seen from the illustrations, is provided with a heavy leather carrying strap.

Fig. 2 is the standard switchboard made by this company. This is equipped with the company's visual signal, and is designed for use without the old-type drop or falling shutter. When a subscriber calls, the signal appears as a bright indicator, and locks until the operator answers the call by plugging in, when the indicator is released and the signal immediately disappears. This can not happen, however, until the operator answers the call, nor can a signal appear unless a subscriber calls. A sudden jar of the board will not cause the number to indicate, as is the tendency with the old-style drop. The jack and signal are self-contained and self-restoring, and are mounted five on a strip, which measures eight and one-quarter by one and five-eighths inches.

The "Eaco" jack and line signal combined, which is called the "visual line equipment," can be removed from the switchboard separately and independently of any other line equipment by the simple method of removing a nut which acts as the jack bushing on the front of the board, and taking the target off the armature line. When the line equipment is removed from the board the signal lines

FIG. 2.—STANDARD SWITCHBOARD.

may be removed by simply unsoldering the leading-in wire and pulling the coil out endways. The armature remains adjusted in the line equipment, and the removal of the coils does not in any way interfere with the armature, which stays

FIG. 3.—PLUG.

in position. The locking device is new and novel, a small permanent horseshoe magnet being fastened to the bottom of

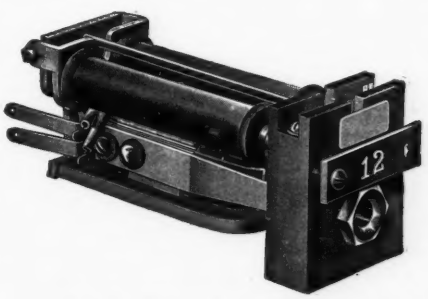


FIG. 4.—VISUAL LINE EQUIPMENT.

the jack in such position that when the armature is attracted by the line coils to the electromagnet it sticks or freezes to the permanent magnet and holds the target or indicator in view until the call is answered and the plug is inserted in the jack. The plug engages a plunger in the jack, which in turn pushes the armature away from the permanent magnet, and restores the signal to its former position. Fig. 3 gives a very good idea of the plug, and Fig. 4 shows the complete visual signal line equipment.

The clearing-out drops are of the tubular-armored type, and are wound to a resistance of 500 ohms. The ringing and listening key is provided with platinum contacts throughout, and is entirely dust-proof. The plug is so constructed that no brass parts are exposed on the outside, which obviates the possibility of the operator receiving a shock. The sleeve of this plug is grooved on the outside, and is made from tough, black fibre, well polished. The sleeve screws on to the body of the plug, and is not fastened with any set screw from the outside.

A New Private Line Telephone.

The accompanying illustration shows a new idea in a monoplex telephone which has been brought out by Atwater Kent, of Philadelphia, Pa., for private line service. A large amount of time and con-

PRIVATE LINE TELEPHONE.

siderable effort have been put forth to develop this instrument, and the maker feels that in presenting the monoplex he has a well-constructed instrument which will become very popular in use. This telephone will talk over a distance of three miles, and is admirably adapted for use in offices, factories, hotels, apartments and private houses.

The receiver is of the watch-case type, and, aside from the rubber cap, is practically in one piece. The hook has a long lever, consequently a maximum motion at the contact with the least motion of the hook. All connections are soldered, and the panel-posts are marked

so that no skill is required in setting up and connecting the instrument. The hook contacts are compact, and they are so arranged that there is little chance of their being thrown out of adjustment. Two wires only are needed between the two instruments, and so that anybody with ordinary mechanical skill may set them up, complete directions are issued by the manufacturer.

Telephone Protectors.

A suitable protector for telephone circuits, to answer all requirements, must provide an easy path to earth for the static discharge of lightning, and must be provided with a fuse capable of satisfactorily handling any discharge occasioned by a cross with a lighting or power circuit, and, further, the device must be so sensitive that it will operate in case of a partial cross resulting in the establishment of minute or so-called sneak currents which will destroy the apparatus if not intercepted.

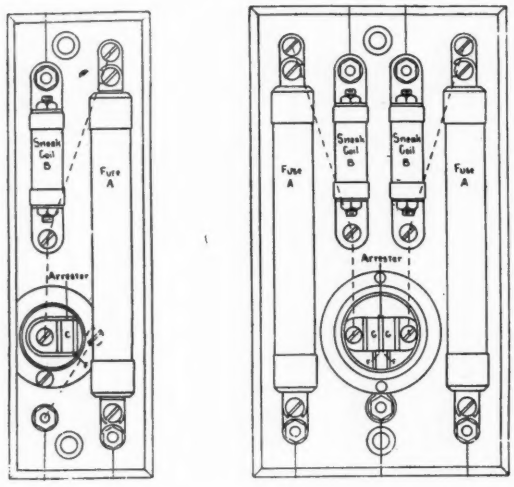


DIAGRAM OF TELEPHONE PROTECTOR CONNECTIONS.

The protector which is manufactured by the D. & W. Fuse Company, the connections of which are shown in diagram in the accompanying illustration, is the result of constant study of this subject during a period of several years. It is designed more particularly for use on subscribers' premises, and is manufactured in both double and single-pole types for metallic and grounded circuits respectively. Referring to the illustration, which shows the construction of the device with its connections for both single and double-pole, the high-tension fuse, A, is connected in series with the sneak coil, B, the two being shunted to earth through the carbon plate diverter, C, which is normally open. The fuse is constructed upon the same principle as the non-arcing, high-tension fuse made by this company, and is capable of handling any current up to a short-circuit at 3,000 volts without arcing or flash.

The sneak coil is extremely simple and effective, and possesses a very great degree of sensitiveness and accuracy. These are made to operate on from one-tenth of an ampere up to one-half of an ampere.

The lightning arrester is of the carbon plate type, consisting of a carbon block separated from the ground-plate by mica or by an insulating water-proof film. With the mica an air-gap of 0.008 of an inch is provided, whereas with the film but 0.0025 of an inch separates the carbon from the ground-plate. To refer again to the diagram, the carbon blocks are designated by C, and the insulating films by F. The entire arrester is enclosed in a metallic casing which prevents the accumulation of dust which has frequently been found to cause trouble, and also guards against any risk from the ignition of lint or flying particles during the instant when the discharge occurs across the plates.

New York Electrical Society's Annual Meeting.

There was a large attendance at the dinner of the New York Electrical Society, at the Café Boulevard, on June 12. After dinner was held the annual meeting for the election of officers, which resulted as follows: President, Dr. Samuel Sheldon; vice-presidents, H. A. Lardner (reelected), Geo. Herbert Condict (reelected), H. V. A. Parsall (reelected), W. I. Donshea, Hobart D. Betts and W. S. Barstow; secretary, G. H. Guy (reelected); treasurer, H. A. Sinclair (reelected).

The secretary's report showed that the year started with 611 members, 134 members have been elected during the year, 17 have resigned and 265 have been struck off the rolls for non-payment of dues. This leaves an existing membership of 513. The report of the treasurer showed that there was a balance in the treasury of $206.77.

The Franklin Institute.

The bulletin for the month of June, issued by the committee on meetings, contains several topics of interest to the electrical fraternity. For Wednesday, June 18, at 8 P. M., the following papers have been arranged: "Viscose and Its Applications," by Dr. J. Merritt Matthews, of Philadelphia; "The Heany Enclosed Arc Lamp," by Mr. J. Allen Heany, of Philadelphia.

CONVENTION OF TELEPHONE MEN.

THE INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES MEETS IN PHILADELPHIA NEXT WEEK.

The sixth annual convention of the Independent Telephone Association of the United States will be held in the city of Philadelphia on June 24, 25 and 26. The headquarters will be at the Hotel Walton, and the convention will be called to order at ten o'clock Tuesday morning. The sessions will be held in the Palm Roof Garden of the Hotel Walton. Tuesday afternoon will be devoted to sightseeing about the city. The business session will be held on Wednesday morning, and this is to be followed by a tally-ho ride up the Wissahicken on Wednesday afternoon. On Thursday morning another business session of the convention will be held, at which time the election of officers will take place, and at the close of the convention an excursion will be given to Atlantic City.

Mayor Samuel H. Ashbridge, of Philadelphia, will make the address of welcome, and the response will be made by the Hon. S. P. Sheerin, secretary of the association, which will be followed by the annual address of the president, the Hon. James S. Thomas.

The following papers will be read: "The Telephone Situation in the Northeast," by L. A. Goudy, Northeastern Telephone Company, Portland, Me.; "The Telephone Situation in the Northwest," by C. H. Judson, Twin City Telephone Company, Minneapolis, Minn.; "How They and We Do Things in Massachusetts," by Nathl. N. Spofford, People's Telephone Company, Haverhill, Mass.; "The Financial Status of the Independent Telephone Movement," by Hon. H. D. Critchfield, Cleveland, Ohio; "Where We Were and Where We Are," by Hon. L. J. Hackney, Indianapolis, Ind.; "The Independent Telephone Situation in the West," by C. E. Wells, Marion, Kan.; "The Independent Telephone Situation in the Southwest," by Z. B. Campbell, Lone Star Telephone Company, San Antonio, Tex.

The Keystone Telephone Company, of Philadelphia, and other independent telephone companies of Pennsylvania desire to extend some social courtesies to the delegates, and they have been assured that their invitations will be accepted.

The railroads have granted a rate of one and one-third fare to Philadelphia and return. Delegates attending the convention will be required to pay full fare going. They should secure proper credentials from their local ticket agent, which, when stamped by the special agent (who will be in the convention hall on Thursday) and presented to the ticket agent at Philadelphia, will entitle them to return for one-third of the regular fare.

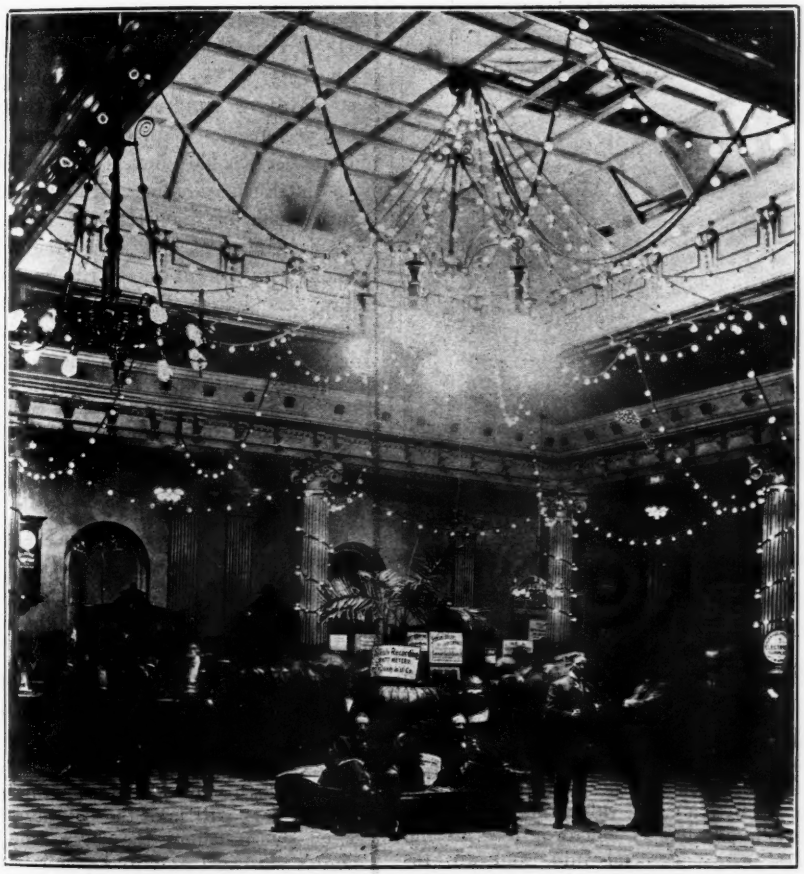
The local committee is Samuel E. Wayland, Robert H. Foerderer and Charles E. Wilson. Mr. Wayland, chairman of the committee, may be addressed at the Keystone Telephone Building, Philadelphia, Pa.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Incandescent Lamps and Decoration.

At the recent convention of the National Electric Light Association there were some interesting points brought out by several competent speakers as to the value and the increasing popularity of small incandescent lamps as a means of effective decorating. Several places at convention headquarters were elaborately festooned, and ample opportunity was given to the delegates and attendants to witness the facility and completeness with which displays could be accomplished.



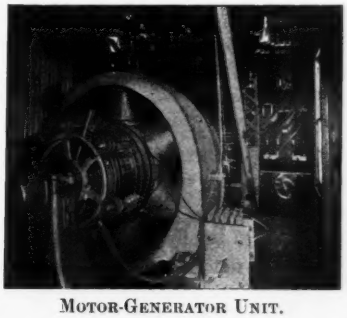
SNAPSHOT-PHOTOGRAPH, SHOWING ELECTRICAL DECORATIONS IN CORRIDOR OF GRAND HOTEL, CINCINNATI, OHIO.

From the accompanying illustration a faint idea may be conceived of the decorations in the corridor of the Grand Hotel at Cincinnati. This was accomplished by means of the "Elblight" system manufactured by the National Improvement Company, of New York city. The system consists essentially of twin conductors heavily insulated with self-healing material. Approximately 300 very fine wires are meshed in these cables, and two sharp-pointed terminals in the frosted bulb make connections with the conductors of opposite sign.

A study of the engraving brings out very clearly the fact that justice can not be done with ordinary reproducing apparatus. Only those lamps which were equipped with white bulbs show very plainly in the photograph, those equipped with green bulbs showing as mere specks, and not as luminous objects. The effect, however, in reality, is one of great beauty, and elicited warm praise for those who had this excellent work in charge.

Electrical Equipment for Coal-Hoisting Towers.

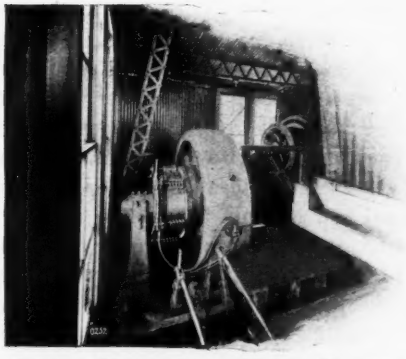
The problem of fuel supply in great power-houses is one which has given the engineer much reason for thought and the exercise of careful judgment. There are a number of power-houses in New York, Baltimore and other cities which are far from the sources of fuel supply, and whose consumption of fuel each day is greater than any one ordinarily conceives. The handling of this fuel is a problem of serious moment. It must be done with certainty and celerity, without excessive noise or dirt and at a nominal cost.



MOTOR-GENERATOR UNIT.

In the new boiler house, now building, of the central power station of the United Railway and Electric Company, Baltimore, Md., thirty-two 500-horse-power Babcock & Wilcox boilers are to be located on two floors and in two sections. Four stacks, 200 feet in width and 13 feet inside diameter, divide the entire building into two parts with batteries on either side. Above the boilers are two coal storage bins with a capacity of 6,000 tons. Each bin is 32 feet wide, 24 feet deep and 128 feet long.

The arrangement of the plant necessitates raising the coal to a great height, which, together with a large fuel consumption, made the conditions most exacting. The coal-hoisting towers and machinery were designed and constructed by the C. W. Hunt Company, New York, while the arrangement of the electrical apparatus in the tower is due to P. O. Keilholtz, consulting engineer of the United Railways and Electric Company.



HOISTING MOTOR CONNECTED TO HOISTING MECHANISM OPERATING STEAM SHOVEL.

On the east side of the boiler house two

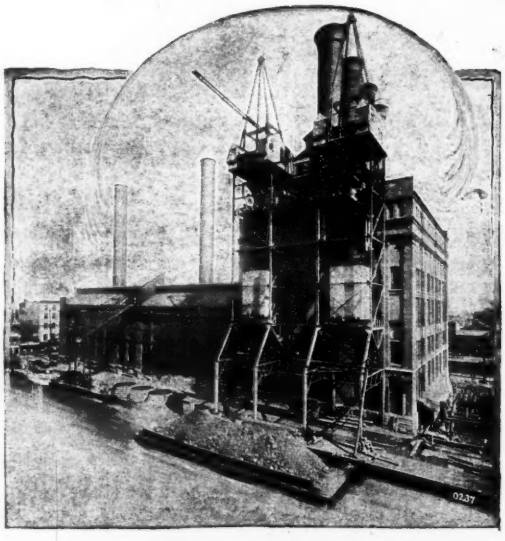
steel towers were built for hoisting the coal, one of which has been equipped throughout, while work on a duplicate equipment is in progress. This plant has the double distinction of having the highest hoist of any power station, and being the only one of its kind equipped throughout with electrically operated hoisting and conveying machinery. Each of the coal-hoisting towers is 183 feet high, and the horizontal booms, fifty-two feet in length, extend over the water. The one-ton shovel is lowered by means of a cable passing over a truck which runs back and forth on the booms to the shovel below. The shovel hoist and boom truck are driven by electric motors geared to the drums.

From the railway switchboard in the adjoining engine room a 550-volt main extends into the coal-hoisting towers. On the first floor of the tower is a motor-generator set. The motor and generator are of the standard General Electric types. From this motor shaft the coal-crusher is also driven. The purpose of this generator is to supply a suitable voltage current to the hoisting motor on the fourth floor above.

As the turning effort is transmitted through gears to the hoisting drums, it is essential that the gears be not subjected to violent shocks by a sudden application of power. The mechanism is such that the rate acceleration is even and dependent upon the will of the operator. The hoist motor has ample capacity to operate the shovel.

When the shovel descends to the coal in the barge, the hoisting motor is started and closes the shovel, fills it with coal, hoists it, loaded, 151 feet over the tower, and dumps the coal into a hopper at the front of the tower on the engine platform. The shovel is then lowered open to the coal and is ready for another trip. An engineer and assistant regulate the operation of the hoisting machinery from the second platform in the tower, the former controlling the hoisting drum motor and regulating the speed and direction of rotation; the latter controls the motor hoist actuating the trolley on the boom. The shovel does not twist in hoisting or lowering, notwithstanding the great height of the hoist. The coal passes from the hopper through a Hunt coal cracker, where the large lumps are broken to the proper size for automatic stokers. By means of a double-jawed cutoff valve the coal is fed into a Hunt automatic railway car, then weighed. After the car is pushed off the scales it passes to an inclined track over the bins, and is automatically discharged by a stop previously located at the point where the coal is needed. The inertia of the loaded car on the incline is stored in a counterweight which, when the load is dumped, returns the car to the scale for another load.

The tower has a capacity of fifty tons of coal per hour. Recent records show that the hoist will deliver considerably more coal than the capacity given above. While the consumption of coal in a station of this size would probably be 100,000 tons per year, the coal-handling plant has a capacity of ten times that quantity of fuel taken from the boat and delivered to the storage bins.



COAL-HANDLING APPARATUS, PRATT STREET STATION, 19,500 HORSE-POWER.

Under each of the boilers is an ash hopper with a cutoff valve, the Hunt noiseless gravity bucket conveyor receives the ashes which descend into, and are removed from, the hoppers by gravity. The ashes are carried over the coal pockets and dumped into a chute leading into ash-bins in the tower, from thence they are removed by car or boat. This conveyor is 430 feet long with a vertical lift of eighty-six feet, and is motor-driven. When carrying a load of ashes, it requires but five horse-power to keep it moving, which is a demonstration of its mechanical efficiency.

No shoveling or manual labor of any kind is required in receiving, transporting or emitting coal or ashes from this plant, and the machinery is as nearly automatic in its operation as possible. The Pratt street station is a good example of what can be accomplished with Hunt coal-handling apparatus, and illustrates how the fuel and ashes of a metropolitan power-house are handled with maximum convenience and economy.

New York Electrical Society Badge.

The new badge of the society is now ready for distribution. The comment has often been made that the badges of the leading societies were all very much alike, and that while the members themselves might be familiar with them, the public frequently failed to recognize any material difference between them. The new badge of the society may be welcomed as being one of the most distinctive and original that has been adopted by a technical body in many years, not only having a character of its own, but embodying symbolically the underlying ideas that are broadly connected with the electrical art and industry. The design of the badge is a modified circular medallion five-eighths inch in diameter, the modifications consisting of four semi-circular extensions equi-distant on the rim, and containing the letters N - Y - E - S in blue enamel. The rim is a gold band three-thirty-seconds inch wide on the face and ornamented with engraved scrolls; the centre is a field of blue enamel containing a vertical compass needle of gold.

The National Electrical Contractors' Association.

The annual convention of the National Electrical Contractors' Association will be held in Philadelphia, beginning on July 16. The headquarters of the association will be at the Hotel Walton. On July 16, at 9 A. M., the directors will meet at the hall of the Franklin Institute. The first delegates' meeting will be called to order at the same place at 1.30 P. M. on July 16. After the meeting on this day, a special boat will take the delegates and invited guests along the river front to Cramp's shipyard and to League Island. A dinner will be given to the delegates in the evening at seven o'clock. On July 17 the meeting will be called at 2 P. M. on the steel pier at Atlantic City, N. J., a special train, leaving Philadelphia for Atlantic City at 9 A. M. on July 17. The entertainment committee will provide transportation to and from Atlantic City and tickets will be furnished to allow the holders to return any time within six days, so that the delegates can remain in Atlantic City, if they desire to do so. The convention will adjourn on the afternoon of July 17.

It is expected that a very large representation will be present, and that the meeting will be a most important one. The topics will be of interest to all electrical contractors, and, whether members of the association or not, they are cordially invited to attend.

Electrical Measuring Instruments.

On January 1 the Cutter Company, of Philadelphia and New York, assumed the entire sales management of the line of electrical instruments made by the Keystone Electric Company, of Philadelphia,

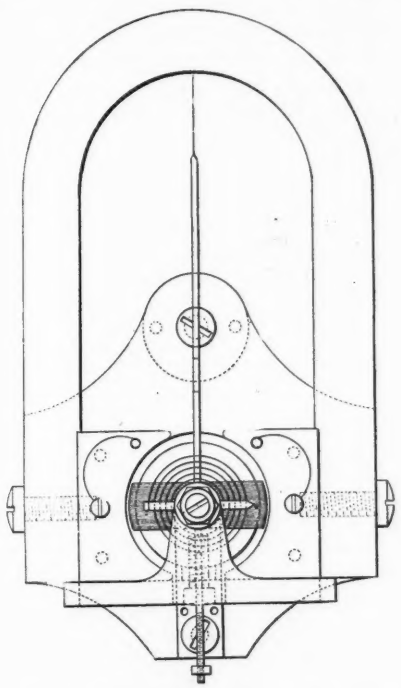


FIG. 1.—PLAN AND SECTION OF DIRECT-CURRENT INSTRUMENT.

of which company Mr. J. Franklin Stevens, M. E., is the president. In describing the measuring instruments illustrated herewith, the subject matter has been abstracted from a treatise prepared by him on this topic.

All of the direct-current instruments, whether switchboard or portable, are constructed under the principle of the Deprez-D'Arsonval galvanometer. In Fig. 1 is illustrated the construction employed by this company in all these instruments, and while the original principle has been maintained throughout, many structural details have been greatly improved upon as compared with earlier types. As will be noted from the figure, the entire system is mounted upon a solid base-plate, rendering it self-contained and independent of any deformation which might take place in the containing-case. In portable types this is a point of particular importance, as the wood containing-case is liable to warp slightly, with a possibility of changing the relative positions of the different parts, causing them to bend or stick if they were separately mounted. Fig. 2 is a section through the centre line of Fig. 1.

The permanent magnet field is made of a single piece of selected magnet steel, forged, machined, magnetized and aged in the company's plant, under expert supervision. The magnetization is kept below twenty-five per cent of the total capacity of the steel, ensuring the production of a magnet, the permanency of which can be positively guaranteed. The company claims that there is no measurable decrease in magnetism even after three or four years' continuous use.

The pole-pieces are made of soft steel, and are permanently secured to the magnet, the joint between the pole-pieces and the permanent magnet being grounded,

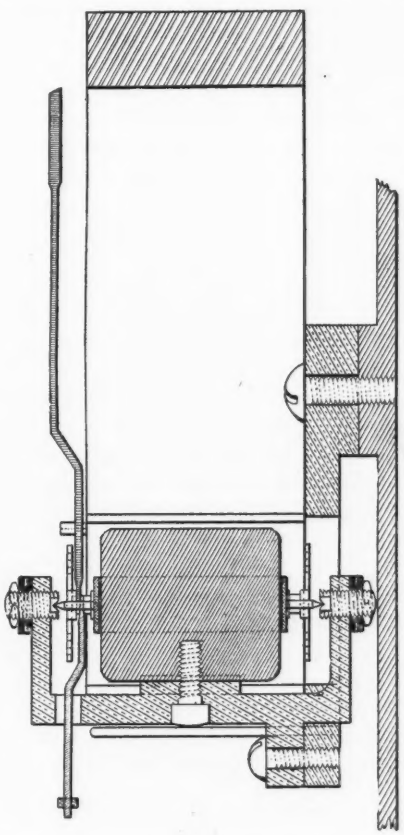


FIG. 2.—SECTION THROUGH CENTRE LINE OF FIG. 1.

and once made is never disturbed. With the large section of the permanent magnet, a generous air-gap is employed between the pole-pieces and the soft iron core, which renders it practically impossible for the removing coil to stick or bind. The entire moving mechanism is mounted separately from the field. The core is mounted on a cast-brass bracket which also carries the moving coil, pivots, spring and jewels, so that the entire moving system may be readily lifted from the field without the necessity of removing the pole-pieces or incurring any consequent damage. The moving coil consists of a layer of copper wire short-circuited on itself for the purpose of damping the movement of the coil by the generation of eddy currents within it, thus rendering the instrument dead-beat in its indications. The active winding of the coil which is superposed on the short-circuited layer consists of a number of turns of fine copper wire, to which current is conveyed by means of the controlling springs, and which in the case of a voltmeter is connected in series with the resistance, and in the case of an ammeter is connected across the terminals of a shunt block. Two small insulated buffer springs make it impossible for the pointer to touch the containing-case and cause a bending of the pointer, or a short-circuit if the case is grounded, by limiting its movement. Carefully selected and ground sapphire jewels are employed, and the pointer consists of a rod of hardened aluminum wire formed up with an eye for attachment to the axis. The actual temperature coefficient of the resistance

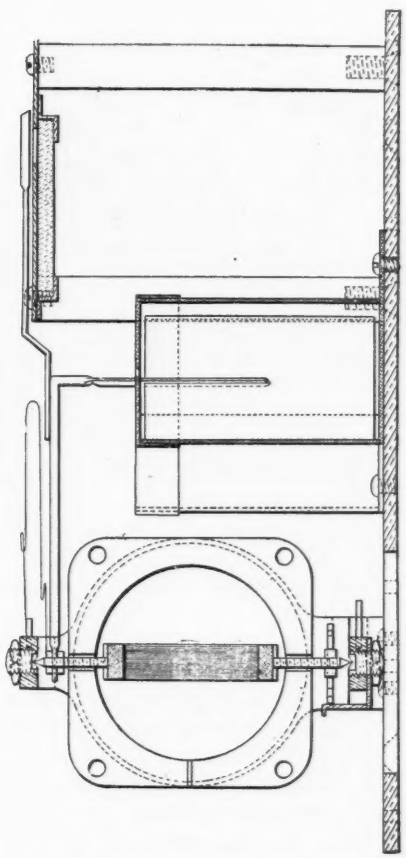


FIG. 3.—ALTERNATING-CURRENT INSTRUMENT, SHOWING VANE IN AIR-CHAMBER.

metal employed is one-tenth of one per cent for 100 degrees centigrade.

All of the alternating-current instruments, except ammeters, are constructed on the principle of the electrodynamometer, which principle is based on the mutual attraction between two coils

through which the current passes, one of which is fixed and the other movable. The original construction of the electro-dynamometer has been modified in several respects in order to make portable direct-reading instruments which will be aperiodic without in any way sacrificing the inherent good qualities of the dynamometer system. As the governing law of this type of instrument is the law of current squares, it follows that in the case of voltmeters equally divided scales can not be obtained. In the case of wattmeters, the scale is approximately equally divided, due to the fact that the movement of the moving coil is proportional to the product of the current in the fixed and moving coils. With the employment of a patent combined system of springs, the maker of these instruments claims to have succeeded in obtaining more nearly equally divided scales than has heretofore been considered possible. This system consists of

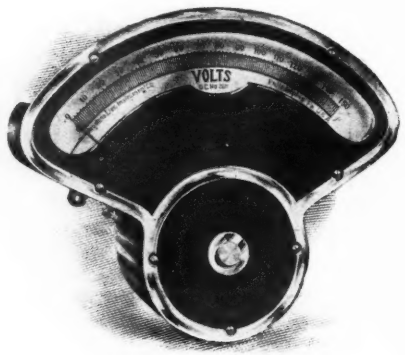


FIG. 4.—VOLTMETER READY FOR MOUNTING.

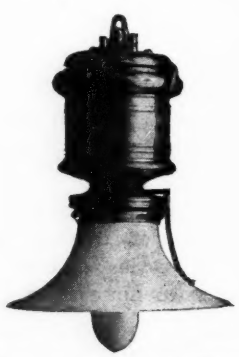
one spiral spring, and a spring which is termed a pendulum spring, so related one to the other that the pointer when at zero is held in what may be termed a dynamic state of rest, rather than in a static state of rest. The spiral spring uniformly opposes the movement of the moving coil, while the pendulum spring assists the movement of the moving coil through the first half of the scale, then acts with the spiral spring and helps it oppose its movement through the second half of the scale, it following that the control is weak when the deflector forces are weak, and automatically increases in strength as the deflecting force increases in strength.

The motion of the pointer is rendered aperiodic by the use of an aluminum air vane moving in a partially enclosed chamber. This may be clearly seen in Fig. 3. This method of damping the oscillations of the moving parts rendered unnecessary the use of mechanical brakes or other frictional devices which might tend to impair the accuracy of the instruments.

Two forms of scales are employed in indicating instruments—one drawn on opal glass, for the use of instruments in which the scale or dial is illuminated by means of an incandescent lamp; and the other drawn on bristol-board where the illuminated feature is unnecessary. In illuminated-dial instruments the opal glass scale is self-supporting, but where bristol-board is employed the necessity of securing it to a metal backing has led the company to adopt a sheet of perforated metal as the support for the bristol-board. With the use of shellac or similar cement, the bristol-board is held down firmly and evenly to this sheet of perforated zinc, the cement forming innumerable rivets which obviate the defect of swelling or blistering, with the consequent binding of the pointer and error in calculations. Fig. 4 shows a voltmeter ready to be set up on the switchboard.

Novelties in Enclosed Arc Lamps.

When enclosed arc lamps were introduced to the public, and so immediately became an element of popular favor, it was generally acknowledged that there was room for some subdivision of the standard light; in other words, there seemed to be a place for a smaller arc lamp, two of which would take the same current as a five-ampere standard lamp. With this object in view, the Lea Electric Manufacturing Company, of Elmwood, Ind., has placed a miniature lamp before the electrical trade which requires two and one-half amperes. This employs the smallest carbon ever used in an arc lamp. The lamp is highly commended

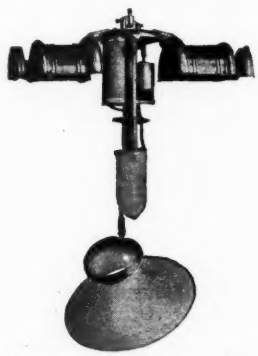


SHORT ENCLOSED ARC LAMP, TWENTY-TWO INCHES OVER ALL.

and has been in successful operation in large cities where it has been shown.

The weight of this lamp is ten pounds, complete with the shade and globe, and in comparative illuminative effect it is about 400 candle-power. It needs trimming once in seventy-five hours.

The demand for a short lamp, of light weight and efficiency and which will be economical in operation, together with convenience in adjustment, has led this company to design the lamp shown in the accompanying illustration. The weight of this lamp, with shade and inner globe, is only twenty-four and one-half pounds, and it measures twenty-two inches over all. The 110-volt lamps may be adjusted to consume from four and one-half to five amperes; the 220-volt from two and one-half to three and one-half amperes. The lamps burn singly across a 110 or 220-volt circuit and may be adjusted from 100 to 125 or from 200 to 250 volts, respectively. A striking point in the construction of these lamps is the swinging, hinged cover for both indoor and outdoor types. These automatically catch and open and remain in place, making every part perfectly accessible, and when closed they snap together tightly and are locked by giving



ENCLOSED ARC LAMP, OPEN, EXPOSING INTERIOR DETAIL.

a few turns to the round nut. The globe or shade is held by a metal ring which catches into the cover by a single pawl. These can be removed or replaced. The resistance is changed by loosening a screw and slipping up or down a contact band. The current is altered by adding small weights to or taking them from a metal cup placed on the lever over the dashpot. The resistance is wound on two solid grooved porcelain pieces which the manufacturer claims can not short-circuit or burn out.

The upper carbon is entirely enclosed. This prevents the air from entering around it into the inner globe and greatly decreases the carbon consumption. The lower carbon is held by a cam lock which prevents breakage and makes it very secure. A solenoid, lever, dash-cup and clutch make up the actuating mechanism of these lamps, making a very simple and efficient construction.

Automatic-Wheeled Conduit Rods.

The conduit rod shown in the accompanying illustration has been evolved by a practical conduit workman, from an experience of several years, during which time he rodded several millions of feet. These rods possess all the good qualities of the solid joint, and have, in addition thereto, the advantages of being quickly connected and disconnected and of being easily pushed or drawn through the ducts.

The celerity with which these rods are coupled and uncoupled, and the ease with which they are pushed into the ducts,

WHEELED CONDUIT ROD.

make them very desirable, and they are simple in construction, durable, and will not buckle or form a zigzag line when they are pushed through the conduit.

In using rods with joints that are easily detached the rods have a tendency to buckle when they are pushed through the ducts, and under the strain a zigzag line is sometimes formed, which destroys the alignment, and, in consequence, the ends of the rods are pressed against the sides of the conduit and cause considerable friction, making it necessary sometimes to employ the combined strength of several men to manipulate the rods. These disadvantages have been determined in the Villard automatic-wheeled rod which has a secure and quickly applied coupling. And they are also very light running owing to their being provided with wheels.

In their construction, special provision is made for their becoming rigid when they are pushed through the conduits and flexible when they are pulled, thus allowing a considerable variance when crossing a manhole and making it easy to take another duct out of line with the first, the rods becoming again rigid when pushed into the new conduit on the opposite side.

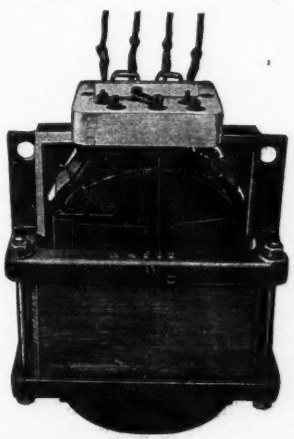
It is a physical impossibility for the rods to become uncoupled while in the conduits, owing to the fact that the rods have to be raised twenty inches, or to an angle of about forty-five degrees before they can be separated. These rods are made with hard bronze couplings, the wheels being of chilled cast iron, and the rods of first-class seasoned hickory soaked in oil. The soaking of the rods in oil prevents their absorbing moisture, thereby prolonging the life of the wood. The rods are fastened securely in the ferrules, with a wedge at the inner end, which enables them to stand more tension than they would if they were fastened by the ordinary riveting.

The wheels, the maker claims, serve three purposes: First—They save friction and wear on the rods themselves, enabling one man to push with ease a set of 200 rods or 600 feet. The ordinary section length averages approximately 400 feet, thus making rodding with Villard rods light work. Second—They serve as duct cleaners, each pair of wheels bringing out a quantity of dry dirt or mud as they are removed from the conduit or passed through a manhole, leaving the duct comparatively clean. In removing obstructions a hard blow can be struck with telling effect with these rods without the slightest injury to the rods. Third—The wheels also act as a guide to the rods, which cause them to take a bend or curve as great as two and one-half feet in twelve. The wheels ensure a two and one-half-inch duct opening through the entire section length, thus allowing a cable of that dimension to be installed without any danger from obstructions.

These rods are regularly made in hickory seven-eighths of an inch and one inch in diameter by three feet long and in special sizes to order. James S. Barron & Company, New York, are sole agents.

A New Transformer.

The Westinghouse company has taken another step forward in the practice of winding for two primary and two secondary voltages by bringing out a trans-



NEW SPECIAL VOLTAGE TRANSFORMER.

former provided with additional voltages. The new transformer, type N, is not intended to replace the company's well-known transformer, but rather to fill the demand for a reliable transformer which, provided with additional ratios of transformation, has a greatly extended range of voltage. The shell type of construction used in Westinghouse O. D. transformers and on the large high-voltage transformers up to 100,000 volts and 2,750 kilowatts capacity.

The primary winding of the type N transformer is divided into equal parts, which may be connected in series or in multiple. The secondary winding is divided into four equal parts, which may be connected in series, series multiple or multiple. The primaries of all transformers are wound nominally for 1,000

NEW SPECIAL VOLTAGE TRANSFORMER.

and 2,000 volts. Transformers from one-half to twenty-five kilowatts, inclusive, are wound for nominal secondary voltages of 50, 100 and 200 ("Class 200"), and those from two to fifty kilowatts, inclusive, for voltages of 100, 200 and 400 ("Class"). The secondary voltages in each class of transformers can be varied to suit either the varying line voltages of an extensive transmission system, or to give special voltages from standard circuits. All transformers are arranged for three-wire secondary distribution, and the secondary coils cross-connected to give equal voltages on both circuits, even with large unbalanced loads.

The following letter has been received from a correspondent:

"I saw several weeks ago a notice in the ELECTRICAL REVIEW of the incorporation of the Cuban Telephone and Telegraph Company, by Messrs. F. C. Prest, E. G. Vaughan and W. J. Patterson. Can you give me any information as to the headquarters of this company? I would like to apply for a position. (Signed) C. G. Davis, 246 Arch street, Sunbury, Pa."

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

ST. LOUIS TRACTION DEAL—It has been announced that plans are under way for the filing of articles of incorporation in New Jersey for the East St. Louis & Suburban Company and the consolidation of St. Louis traction lines. The new company will have a capital of $5,000,000, and an authorized bond issue of $8,000,000. The properties involved are said to be the East St. Louis Railway Company, St. Louis & East St. Louis Electric Railway, East St. Louis Suburban Railway, and St. Louis & Belleville Electric Railway. E. W. Clark & Company, of Philadelphia, are managing the financial part of the deal. It is believed that the plans will be completed this month.

GOVERNMENT NOT TO LAY PACIFIC CABLE—The House of Representatives has struck out the enacting clause of the Corliss Pacific Cable Bill. The government will not become a competitor, and as the line will be in successful operation, it is expected, by next November, on terms acceptable to the government, all agitation for a Pacific cable under national control has practically ended. At the last session Representative Richardson, of Alabama, read a letter from John W. Mackay, of the Commercial Company, guaranteeing that the company would build an all-American cable and not touch upon foreign soil. The objection to the project because the cable was not manufactured by American labor, he said, would not stand investigation. He produced figures to show that only twelve per cent of the cost of a cable was expended for wages. During the debate the question was brought up as to whether any cable had already been manufactured by the Commercial Pacific Cable Company. Upon the counsel of that company making specific enquiries, the information from the managing director of the India Rubber and Gutta Percha Works Company brought out the fact that the company had already manufactured 1,065 nautical miles of submarine cable, which was to be laid between San Francisco and Honolulu for the Commercial Pacific Cable Company, and that the balance was being made at the rate of twenty-five miles per day.

POWER PROJECTS IN SOUTH AFRICA—American interests are said to be working on a large contract for the harnessing of the Victoria Falls on the Zambesi River in South Africa. These falls are nearly a mile in width and 420 feet in height. The concession for the sole right to develop power from the falls has been secured from the Chartered Company, of South Africa, for a period of seventy-five years by a concern called the African Concessions Company, Limited. The late Cecil Rhodes is said to have taken a deep interest in the scheme, and quite recently a meeting was held by those interested for the purpose of confirming a resolution increasing the capital of the enterprise from $150,000 to $250,000, the British South African Company taking up $125,000 worth of stock at par; and a board was formed, at which the Africa Trust, the Chartered Company, and the syndicate were equally represented. Sir Douglas Fox and Sir Charles Metcalf, the consulting engineers of the Rhodesia railways, have been appointed consulting engineers. It is proposed to operate the Cape to Cairo Railway for 150 miles, both north and south of the falls, and to operate the recently discovered copper deposits which are within 150 miles to the north, to work the coal fields in the vicinity, and eventually to transmit power down to the Rand to work the mines in that district. It is said that there is practically no limit to the power that can be developed, for even in dry seasons the river is two or three feet deep about the falls and a mile wide. The initial plant will, it is believed, involve an expenditure of $5,000,000.

LARGE TOLEDO COMPANY UNDER NEW CONTROL—The Toledo Railways and Light Company, with a capital stock of $12,000,000, has passed into the control of interests represented by Kean, Van Cortlandt & Company, of New York city. With the transfer of the control of this company the Everett-Moore Syndicate, which controlled the principal street railway systems in northern Ohio and southern Michigan, and which has been in liquidation for several months, loses one of the most important systems in its combination. The Toledo Railways and Light Company controls the street railway system and the electric lighting plant of the city of Toledo. It was organized in July, 1901, and soon purchased all the properties, rights and franchises of the Toledo Traction Company and the Toledo Consolidated Electric Company, which consisted of all the street railways and public lighting business in the city of Toledo. The railway lines of the company consist of 102 miles of standard gauge track, averaging over seventy-five pounds per yard, and extending through the principal streets of Toledo. The Toledo Railways and Light Company has a bonded indebtedness of $12,000,000, of which $4,000,000 is outstanding, $6,000,000 is reserved for underlying bonds, and $2,000,000 is reserved for betterments and improvements. The net earnings for the year ending December 31, after deduction of taxes, were $674,677. The surplus, after interest payments, amounted to $1,220,677, or about two per cent on the capital stock. The gross earnings for the four months ending April 30 showed an increase of $46,823, and the net earnings increased $15,288 over the previous year. It is announced that there will be no change in the management, although the present board of directors will be enlarged so as to give representation to the new controlling interest.

TELEPHONE AND TELEGRAPH

SPOKANE, WASH.—The Sunset Telephone Company is to construct at once forty miles of line extension to Lynden, Everson, Loonsack and Sumas.

RED LODGE, MONT.—The Rocky Mountain Bell Telephone Company has begun work in extending its line from this city to Bear Creek, a distance of about five miles.

BUFFALO, N. Y.—Work on the system of the Frontier Telephone Company is pushed forward with very great rapidity. It is expected that the exchange will be in operation by October next.

DAYTON, TENN.—The East Tennessee Telephone Company has just completed a new telephone line from Spring City to Grandview, located on Walden's Ridge, twenty-four miles north of Dayton.

AUGUSTA, GA.—The Augusta Telephone and Electric Company has been granted a franchise to construct an underground conduit system for electric wires for its own use and for sale and rental to other persons or corporations.

EAUCLAIRE, WIS.—The Wisconsin & Minnesota Telephone Company is petitioning for entry into the city. The new company is building a line from La Crosse to Minneapolis, and wishes to include Eauclaire and other near-by towns in the circuit.

UNIONDALE, IND.—The Uniondale Rural Telephone Company has been organized for the purpose of operating the rural telephone system at Uniondale and vicinity. The directors are: Albert Knight, William Sonner, Isaac Wolcale, J. Orr and Jacob Keiser.

WINCHESTER, IND.—The Eastern Indiana Telephone Company is preparing to extend its service. Telegraphic communication may be had from Winchester over the lines to nearly every town of any size within 100 miles radius except Muncie. The company is to run a line southwest, another east, and another to New Dayton. A number of telephones will be connected, and a copper circuit to Muncie and an iron one to Union City will establish a direct connection with Muncie.

ALTON, ILL.—Announcement has been made of the completion of the deal at Grafton, Ill., for the lease of all the telephone lines in Calhoun County to the Central Union Telephone Company. The deal was consummated by W. W. McKee, of Alton. The lines which have been leased extend from Nebo in Pike County to Grafton in Jersey County, and the lessees will extend a new line from Nebo and Grafton, traversing the length of Calhoun County, taking in all the towns in the county to connect with the Alton telephone exchange.

YUKON, ALASKA—The total cost of the Yukon Telegraph Company, built by the Dominion Government from Ashcroft to the Klondike, was $768,224. This includes the cost of stations. Seventy offices are maintained along the line and 100 men employed. The revenue from the line has been from $6,000 to $9,000 a month, and much of the time during the winter the lines were down. It is proposed now to put in land cables this summer in the most troublesome places, and little difficulty is expected next winter, when it is anticipated that the revenue will be some $125,000.

ELECTRICAL SECURITIES

A steady and gradual increase in interest was evident during the week, which has naturally been reflected in more active dealings, with a steady upward movement of prices. This improvement has been due entirely to professional activity, as the outside public still remains passive with regard to speculation. At the same time, there has been no evidence of any general liquidation, and this feature is the primary cause for the stability of the market. Until the coal strike reaches a stage when a settlement is in sight, or until the crop outlook becomes more definitely established, there is little reason to hope for any material change in the present trading market. Notwithstanding the present upward condition of affairs, there is little which would seem to show that a bull campaign is in progress. Many men of wealth are now leaving the city and curtailing their speculations, and the general situation presents many uncertainties that would render this almost impossible. The coal strike also stands in the way of any pronounced upward movement at this time, and there is still the case of the Northern Securities Company unsettled, which would touch other combinations of transportation interests. Speculative conditions have recently shown signs of ignoring the coal strike, but this can still be classified as the most prominent stock market influence.

ELECTRICAL SECURITIES FOR WEEK ENDING JUNE 14.

New York:	Closing.
Brooklyn R. T.	67⅛
Con. Gas	221
Gen. Elec.	313¼
Kings Co. Elec.	196
Man. El.	131
Met. St. Ry.	150¾
N. Y. & N. J. Tel. Co.	174
Westingnouse Mfg. Co.	210

The Brooklyn Rapid Transit Company, in its report of earnings for April, shows the gross earnings to be $1,041,706, an increase of $51,712; operating expenses, $705,010, an increase of $46,728; and net earnings, $336,695, an increase of $4,984. For the past ten months there has been an increase in gross earnings of $623,474.

Boston:	Closing.
Am. Telep. & Tel.	175½
Edison Elec.	279
Mass. Elec. pf.	98
New England Tel.	149
Western Telephone & Telegraph	102½

Massachusetts Electric preferred is selling around 98½, and the common at about 44. There has recently been quite a bullish sentiment respecting this stock.

American Telephone held firm all week at about 175.

Philadelphia:	Closing.
Elec. Co. of America	7¼
Elec. Stor. Bat. c	90½
Elec. Stor. Bat. pf	90
Philadelphia Elec.	5½
Union Traction	43½
United G. I. Co.	106

Chicago:	Closing.
Chicago Edison Light	178
Chicago Telep.	170
Metropolitan El. pf.	90
National Carbon	23½
National Carbon pf.	93
Union Traction	18¼
Union Traction pf.	55

At the annual meeting of the Chicago Edison Company last week, the board of directors was reduced from 11 to 9. At the meeting of the board of directors, changes were made in both the executive committee and the list of officers. W. A. Fox, who has been assistant, was appointed secretary and treasurer, succeeding F. S. Gorton. Joseph Leiter retired from the executive committee, which is now constituted as follows: Edward L. Brewster, Samuel Insull, Robert T. Lincoln, Erskine M. Phelps and A. A. Sprague.

Union Traction earnings for May showed an increase of $2,193 a day, or a total of $67,000 for the month. The increase for eleven months is $650,000.

ELECTRIC LIGHTING

BOULDER, COL.—At a recent meeting a consolidation was effected between the two electric light companies of this city. This will end a prolonged struggle in which the two companies have been engaged.

CENTRAL CITY, S. D.—Central City is to have electric lights. Contracts have been entered into with the Belt Electric Light and Power Company, of Lead, by a number of business men and citizens of this place, whereby the company is to extend its service from Lead to Central. The linemen are engaged in the work now and will have it completed this month.

EDWARDSVILLE, ILL.—The city council has awarded the electric light franchise to J. R. Harvey, present lessee of the city lighting plant. He will have exclusive rights for ten years and a franchise for twenty-five. He has purchased the plant now in use by the city for $11,000, and will use it until a new and modern plant can be put in, which will be done at once at a cost of $50,000 or more.

WOODBOURNE, N. J.—The Woodbourne Electric Light, Heat and Power Company is the name of a new organization for the purpose of furnishing all-night lights for the borough of Sussex. The incorporators of the new company are John L. Swayze, Esq., of Trenton; Dr. H. D. Van Gassbeek, of Sussex, and Charles Crissman, of Branchville. The new company is capitalized at $30,000.

MIDDLEPORT, N. Y.—Julian C. Smith, of Buffalo, has purchased the good will, plant, water rights, franchises, poles, business, etc., of the Middleport Gas and Electric Light Company. The transfer was made recently, the consideration being named in the transfer deed at $1. There is a mortgage of $30,000 on the plant of the company, and the purchase was made subject to this mortgage.

GREENVILLE, ILL.—At a special meeting of the directors of the Greenville Electric Light, Heat and Power Company it was decided to purchase all necessary new machinery for making a duplicate light plant. This will provide against shut downs, so that should one set of machinery be incapacitated, the current can be switched to the other set and no inconvenience caused consumers. The intention is to use the new machinery for the regular service and hold the old in reserve.

SAN FRANCISCO, CAL.—The United Gas and Electric Company, which was incorporated in San Francisco by E. C. Green, W. Greeg, Jr., C. H. Pennoyer, C. O. Poole and J. E. Green, has purchased the San Jose Light and Power Company's holdings, has bought out the Electric Improvement Company, of San Jose, and absorbed the Consolidated Light and Power Company. The place of the last named company will be taken by the new corporation as the distributor of the Standard Electric Company's current from its new transmission line.

PERSONAL MENTION

MR. WILLIAM J. PHELPS, manager of the Phelps Company, Detroit, Mich., was in New York, at the Imperial Hotel, during the past week.

MR. FRANK B. KNIGHT, well known as one of the pioneer telephone men of the country, special agent of the American Telephone and Telegraph Company, has recently moved his headquarters from Austin, Tex., to Dallas, Tex.

ELECTRIC RAILWAYS

MEDINA, N. Y.—A survey of Medina is being made which, it is announced, contemplates the route of an electric railway through the village. The new road is said to be an extension of the International Traction Company's lines.

LOUISVILLE, KY.—The promoters of the River Road Electric Railway have appointed a committee to confer with the officers of the Louisville Railway Company, to ascertain whether an arrangement can be made whereby the cars of the suburban line can be brought into the heart of the city over the tracks of the Louisville Railway Company.

PORTLAND, ORE.—The Oregon Electric Power Company, which was incorporated in Nebraska a short time ago, with headquarters in Portland, has begun the construction of a large electric power plant in Baker County. The company has an authorized capital of $500,000, and expects to have the plant in operation early in 1903. The power station will be built on Eagle Creek, the largest branch of Powder River, water being led out of the creek by a flume 15,000 feet long, at the lower end of which there will be a fall of 385 feet. It is announced that at the low-water stage the capacity at the point where the power plant is to be built will be 4,000 horsepower. As the demand for power grows, the plant will be added to until its full capacity is reached. It is expected that the line will be extended across to Sumter, power and light being supplied for the mines of that district, as well as for railway and other purposes.

INDUSTRIAL ITEMS

THE OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York, is erecting an addition to its manufacturing plant at Hoboken, N. J.

THE WILLARD STORAGE BATTERY COMPANY, Cleveland, Ohio, is now operating the factory which has been conducted under the name of Sipe & Sigler in the past two years, for the manufacture of the Willard storage battery.

THE LEA ELECTRIC MANUFACTURING COMPANY, Elwood, Ind., guarantees a life of from 50 to 100 hours longer on one trimming for the "Northall" enclosed arc lamps, which it manufactures, than any other arc lamp on the market.

THE READING GAS AND ELECTRIC FIXTURE COMPANY is manufacturing a new line of knife switches, panel boards and switchboards, adapted for all instruments. It is also manufacturing gas and combination lighting fixtures and chandeliers.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., general selling agent for the new type Gutmann wattmeter, has lately issued a very complete wattmeter catalogue. The orders for this instrument show that it is very popular and in great demand.

CHARLES E. DUSTIN & COMPANY, New York city, announce that the company has on hand a fine line of second-hand boilers, engines and railway generators for immediate disposal. Letters of enquiry will be promptly taken care of by this enterprising company.

THE PARTRIDGE BOILER WORKS, Sandusky, Ohio, had a small fire recently which slightly disturbed a portion of its furnace room. Practically, however, no damage was done, as it took only a day to make repairs and the filling of orders was not delayed at all.

THE EMPIRE STORAGE BATTERY AND MANUFACTURING COMPANY, New York, is a new company operating a factory at 154 East Fifty-seventh street and maintaining its offices at 42 East Twenty-third street. The company is manufacturing storage batteries for stations, traction, signal and launch service.

MR. G. M. WILLIS has opened offices in the Monadnock Block, suite 1503, as manufacturers' agent and engineer. Mr. Willis was indentified with the Jewell Electrical Instrument Company, of Chicago, for several years, and is familiar with the electrical industry both from a commercial and technical standpoint.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, of Indianapolis, Ind., has recently installed its special geared linotype motors in the following well-known newspaper offices: Kansas City *Journal*, Pittsburg *Dispatch*, Portland *Oregonian*, Minneapolis *Journal*, Cincinnati *Times-Star*, Baltimore *American*, Kansas City *World*, St. Paul *Dispatch*.

THE GENERAL PASSENGER DEPARTMENT OF THE CENTRAL RAILROAD OF NEW JERSEY has recently issued a very useful little booklet containing a list of hotels and boarding-houses, with rates, etc., along its lines through New Jersey and Pennsylvania. Descriptions of the larger resorts have been issued under separate cut covers beautifully illustrated in half-tones.

THE "FOUR-TRACK" SERIES No. 20, published by the general passenger agent of the New York Central & Hudson River Railroad, is a most comprehensive index to the Adirondack Mountains. Every point of interest is taken up and elaborately described, with hotel rates and other interesting features carefully indexed. A splendid map completes this very valuable addition to railroad literature.

SAN FRANCISCO, CAL.—Mr. George F. Chapman has arrived in San Francisco where he will be general manager of the United Railroads Company's street railway system, in place of E. P. Vining, resigned. Mr. Chapman resigned his position as general superintendent of the North Jersey Street Railway Company at the request of Brown Brothers, of New York, who desired his services with the company in which they are interested.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces that its single-phase, alternating-current motors have again received recognition, the Charleston Exposition having granted the company two gold medals, one on the motor alone and another on the motor in combination with direct-current generator sets. New price lists and bulletins are now ready, and the company will be pleased to furnish these upon request.

THE SCRANTON FIRE BRICK AND CONDUIT COMPANY, with factories at Scranton, Pa., and Ithaca, N. Y., is placing on the market a vitrified conduit for electrical underground construction work. The conduit is claimed to be indestructible, of unusual excellence in insulation qualities and unaffected by chemical action. The company announces that it is not in a "trust." Its general sales agent is Mr. C. J. Harrington, 15 Cortlandt street, New York.

THE MONARCH FIRE APPLIANCE COMPANY, New York city, in order to properly handle its rapidly increasing business, has found it necessary to remove the general offices from 27 William street to Nos. 247 and 249 Pearl street, where the business, manufacturing and shipping departments will be housed under one roof, and where it will be pleased to receive a continuance of the patronage which has been bestowed so generally on Kilfyre in the old location.

THE HUSSEY DYNAMO BATTERY COMPANY, 39 Cortlandt street, New York, is said to be making some interesting advances in the production of primary batteries which will be embodied in a new battery soon to be placed upon the market. The battery which this company now manufactures is claimed to require bi-sulphate of mercury for renewal and to act like a self-feeding stove. Further, it is claimed that three cells of this battery will run a nine-inch fan motor or four cells any twelve-inch fan motor.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has recently closed a contract with the Northern Construction Company for a central energy multiple switchboard for Hamilton, Ohio, of three six-panel, three-position sections having a total present equipment of 960 local common battery lines and twenty toll lines. Each section will contain multiple jacks for 960 lines, making the board fully multiple. The ampere capacity is 3,000 multiple lines. The contract also includes all necessary appurtenances.

J. JONES & SON, 64 Cortlandt street, New York, has just received from the press a new and revised edition of its catalogue of electrical lighting supplies. The catalogue contains several hundred illustrations of equipments used in electric lighting and of apparatus used in connection with it. The book shows careful preparation and much intelligence in the selection of data most likely to interest possible purchasers. In addition to this list, known as "Catalogue No. 12," this company publishes the following catalogues: No. 10, "Bell and Battery Supplies;" No. 11, "Electric Fans;" No. 13, "Panel Boards, Switches and Electrical Supplies;" No. 14, "Telephones."

THE MASSACHUSETTS CHEMICAL COMPANY, Boston, Mass., has removed to new quarters two blocks away from its old Boston office, in the Wentworth Building, 170 Summer street. It is one of the handsomest suites of offices that electrical men visit. The company will there carry on the executive management of the Walpole factory. Electrical men visiting Boston can be sure of a cordial greeting and of seeing samples of up-to-date insulating products. On the return of Chief Engineer Farrington from Europe in the early fall ground will be broken to double the capacity of the present plant which is now running with day and night forces.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, is said to be producing electric fans and motors complete at the rate of 30,000 a year. In addition to fan motors this company manufactures small dynamos and motors. This company has rapidly forged to the front within a few years, it having constructed a large and well-arranged manufacturing plant at Springfield, Ohio, and now operates its own foundries and machine shops. The company maintains a New York branch at 136 Liberty street, under the management of Mr. C. L. Vandewater, and its agent for the New England states is the Frank Ridlon Company, 200 Summer street, Boston.

MR. H. F. SANVILLE, 710 and 711 Gerard Building, Philadelphia, who has just opened a new office for the purpose of acting as the selling agent for electrical railway and lighting supplies, advises us that he is the direct representative for the Albert & J. M. Anderson Company, manufacturer of arc lamps, switches, overhead line equipments, etc.; also for the Wayclark Wire Company; and he is the local agent for the following companies, through Francis Granger, of New York: Corning Brake Shoe Company, Ham Sand Box Company, I. Bliss Manufacturing Company, Lehigh Car-Wheel and Axle Works, New Haven Car Register Company, Hipwood, Barrett Fender Company, Sterling Electrical Manufacturing Company, and Trojan Trolley Fender Company.